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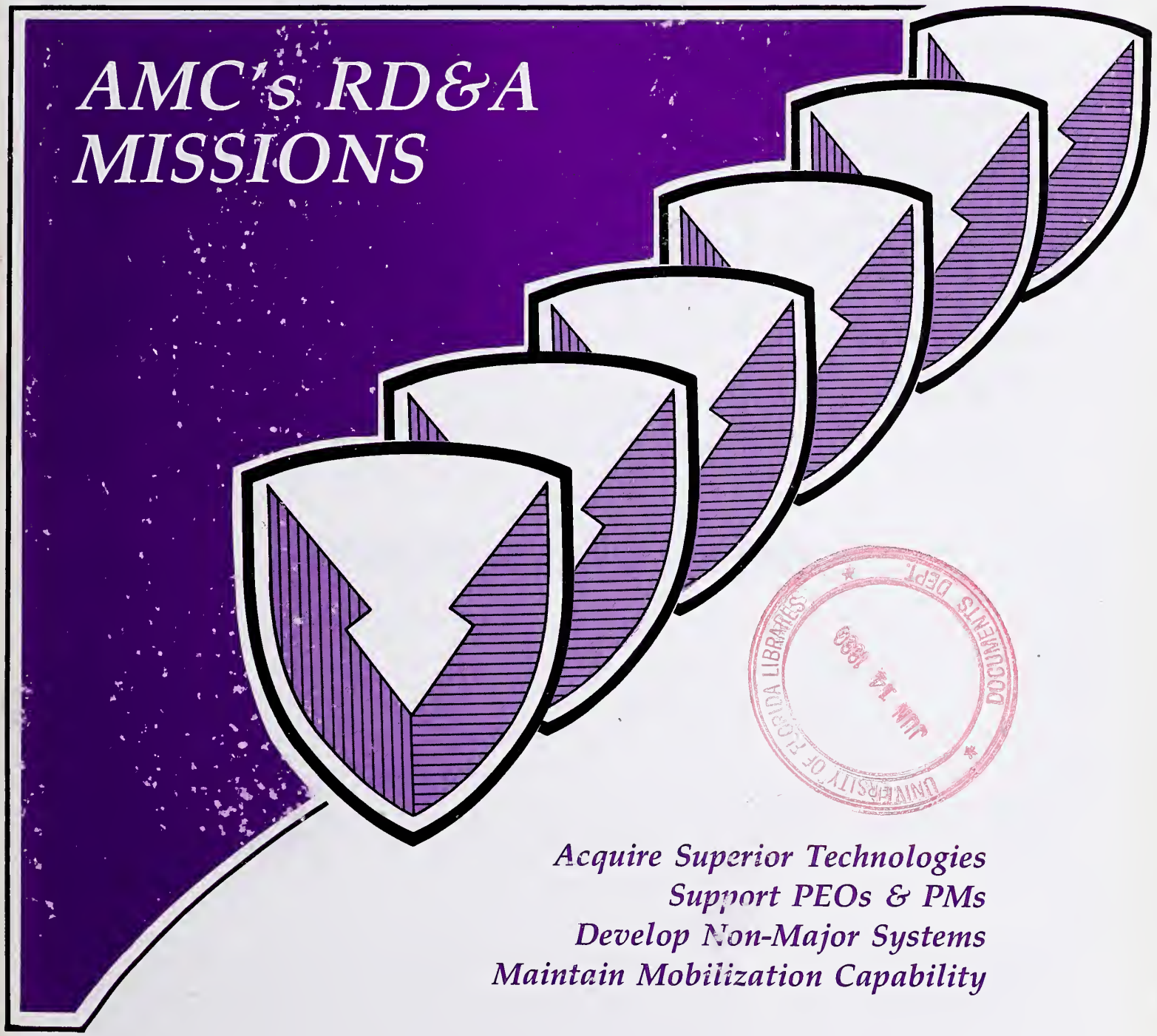
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ARMY RD&A BULLETIN

MAY-JUNE 1990

AMC's RD&A MISSIONS



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Acquire Superior Technologies
Support PEOs & PMs
Develop Non-Major Systems
Maintain Mobilization Capability

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ARMY
Research
Development
Acquisition

RD&A

PB 70-90-3

MAY-JUNE 1990

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ABOUT THE COVER

The front cover relates to a feature article on the Army Materiel Command's role in the acquisition process and achievement of AMC's RD&A missions. The back cover introduces *Army RD&A Bulletin's* new recurring logo. Reader response to the logo is encouraged. Graphics support provided by Ned Owen, AMC Graphics Branch.

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HOW AMC ACCOMPLISHES ITS RD&A MISSIONS

A Thorough Re-examination of AMC's Future Role

By Larry R. Israel

Introduction

One of the very first questions asked following establishment of the 1989 Defense Management Review (DMR) by the U.S. Department of Defense (DOD) was, "Will the Army Materiel Command (AMC) have a major role in U.S. Army acquisition in the post-DMR era?" When the answer to that question was an unequivocal "yes", two other questions quickly followed: "What is that acquisition mission and how will it be performed?"

In light of the dramatic changes which have taken place with the Army's establishment of the program executive officer (PEO) management system in 1987, the sweeping changes now mandated by the DMR, the uncertain changes in the world situation, and the inevitable shrinking budgets facing the DOD, these questions and the responses to them are essential to how the Army and AMC will fulfill their objective of providing the American soldier the best equipment for the best price so that he can fight and win on any battlefield in the world.

Seven Major Missions

As a direct result of these events, there has been a thorough re-examination of AMC's future role in support of the Total Army. In concert with the Department of the Army (DA) leadership and the commanders of AMC's major subordinate commands (MSCs), the AMC Commander, GEN William G.T. Tuttle, Jr., set a course for the future that focuses on seven major missions. These missions are:

- Equipping and sustaining a trained and ready Army (the first mission among equals);
- Providing equipment and services to other nations through the Security Assistance Program;
- Developing and acquiring non-major (non-PEO) systems and equipment;

DEVELOP & ACQUIRE NON-MAJOR SYSTEMS & EQUIPMENT

- Develop and Test
- Procure and Test
- Provide Infrastructure to Support Mission

- Providing development and acquisition support to PEOs/program managers;
- Defining, developing, and acquiring superior technologies;
- Maintaining the mobilization capabilities necessary to support the Army; and
- Improving productivity and quality of life.

AMC's RD&A Missions

It is in these missions that the AMC role in acquisition is clearly defined. Though all of the missions are related to acquisition in some respect, four of them form the core of the research, development, and acquisition (RD&A) mission. These four are the development and acquisition of non-major systems, development and acquisition support to PEOs and their subordinate program, project, and product managers (PMs), the management of the technology base to ensure the acquisition of superior technologies, and the establishment and maintenance of the mobilization capabilities necessary to support the Army.

To define the overall AMC RD&A mission, it is necessary to look at each of these four acquisition related missions and how they are performed.

Non-Major Systems and Equipment

AMC's first RD&A mission is the development and acquisition of non-major systems and equipment, specifically those not managed by the PEOs and their subordinate PMs. This is a responsibility of great magnitude and importance.

The attention paid to the creation of the PEO system and the assignment of the Army's major systems to PEOs has perhaps obscured the fact that AMC retained programmatic authority and responsibility for all non-PEO weapon systems and hardware system programs. ("Programmatic" refers to the actions, decisions, and efforts that directly affect the unit cost, the development and or production milestone schedule, and/or the technical performance capabilities of the acquisition program.) That means that the vast majority of the Army's non-major system programs are assigned not to PEOs, but rather to AMC.

In a recent survey, AMC identified 694 Army non-major weapon and hardware system programs that are currently in the acquisition process. Of those 694 systems, 576, or nearly 83 percent, are managed by AMC and its MSCs. AMC has programmatic responsibility for these systems. Several are assigned to designated PMs who report directly to HQ AMC and/or its MSCs. There are over 40 such PMs. The Army Acquisition Executive (AAE) retains a direct programmatic link to these programs; however, the link is through AMC, not a PEO.

Examples of AMC-managed systems include most munitions (by far the largest program in AMC, it includes buying and managing for other services), the Volcano Mine System, 155mm Baseburn Artillery Projectile, M9 Armored Combat Earthmover (ACE), M113A3 Armored Personnel Carrier, M60 Tank, Small Emplacement Excavator, Aerial Recovery Kit, Integrated Communication Navigation Identification Avionics, Light Assault Bridge, Integrated Power Systems, Army Watercraft, Chemical Agent Detector Network, Large Area/Mobile Projected Smoke System (LA/MPSS), Tactical Explosive System, Chaparral, Hawk, Hydra 70 (2.75 mm rocket), Video Disk Gunnery Simulator for the Bradley Fighting Vehicle, Joint Advanced Special Operations Radio System (JASORS), Integrated Family of Test Equipment, and the HF Multichannel Radio.

While the non-major programs assigned to AMC represent a relatively small resource outlay individually, they are nonetheless critical to success on the battlefield. It is worth noting that while the PEOs had direct responsibility for approximately 53 percent of the Army's research, development, test, and evaluation (RDT&E) budget and 75 percent of its procurement budget (mostly for big-ticket items) in FY 89, AMC was responsible for about 47 percent of RDT&E and 25 percent of procurement. Although individual PEO programs are larger than most non-PEO programs, the number of programs managed by AMC constitutes a healthy share of the RD&A budget.

Most of the management of the non-PEO programs takes place at the level of the AMC MSCs. The MSC commanders are the program decision authorities, while day-to-day management takes place in program offices, MSC system management directorates, or in AMC laboratories. The individual MSC materiel system managers or commodity managers are responsible for the development, production, and fielding of their assigned systems within approved performance, schedule, and cost requirements.

The AMC responsibilities with respect to the mission of developing and acquiring non-major systems and equipment include the following: RDT&E, major and secondary item production and procurement, major and secondary item fielding, total package fielding, and DOD and joint-service support. This is a broad mission. It is one that AMC has been performing for

quite some time, and it is a mission that has been sanctioned by the DMR.

Supporting PEOs and PMs

AMC's second RD&A mission, which it has been performing since 1987, is to provide development and acquisition support to PEOs and their subordinate PMs. The PEO management system was established from recommendations of the President's Blue Ribbon Commission for Acquisition Reforms in 1986 and the DOD Reorganization Act in 1987.

Under this new management system, the AAE, the PEO, and PMs became the decision authorities for programmatic issues for designated programs. Support of the PEO system development and acquisition functions became an AMC responsibility. The AMC role is to pull together for the PEO and PM all the functional services required to execute the acquisition program. AMC provides direct functional support to the PEO/PM through MSC matrix structures, as defined in the organizational context.

Although AMC did not foresee the creation of the PEO management system when matrix support was first introduced in the command in 1985, the matrix approach developed at that time has facilitated the implementation of this functional support mission.

The matrix structure resembles the way combat and combat support units are organized for combat. In fact, the initial assignment of roles and responsibilities between the PM and the MSC was patterned after the field artillery fire support matrix.

This structure gives a readily identifiable split between the PEO's organization and AMC. It provides a sound point of communication between them and ensures that functional standards are maintained for all programs.

How does AMC accomplish this mission of providing the necessary development and acquisition functional support services to PEOs and PMs? How does it ensure that functional support is provided at the right time, in the right amount, and in the most cost-effective manner possible?

The functional support provided by HQ AMC tends to be horizontal in nature since it deals with cross-program policy and procedures and cross-PEO program trade-offs. Examples of such functional support include the following: providing policy standards and ensuring compliance; conducting the requisite total acquisition planning and integration; resolving multi-program policy issues; providing support for labs, test and evaluation, supply and service, procurement, legal issues, and safety; and managing materiel items.

Basic Matrix Support

Matrix support is provided by AMC's MSCs. The details of the structure and operation of the matrix support differ between the various MSCs. However, the basic structure is the same throughout AMC:

- The PEO/PM "core" is a small (about 20 people) staff of managers, coordinators, and integrators who execute programmatic responsibilities and overall program management.
- All functional support is provided from or through the MSC. Some support may be provided by MSC personnel who are collocated with the PM for long periods. However, the bulk of functional support is provided by individuals or teams that are identified with the PM only as long as needed and may be working for several PMs (or on other MSC missions) simultaneously. The MSC Commander has control of functional support resources and shifts resources as workloads and mission priorities change. If resources are not available in the MSC or other agencies, the MSC will contract for support for the PM.
- The functional support provided through the matrix consists of those services required by the PEO/PM that are integral or unique to the materiel acquisition process. These services apply systematized methodologies, procedures, and common standards across materiel acquisition programs.
- Functional support includes, but is not limited to: contracting; resource and financial management; obligation planning and reporting; technical requirements analysis and allocation; cost and economic analysis; auditing; automated data processing; industrial preparedness; test planning and reporting; test, measurement, and diagnostic equipment (TMDE); value engineering; international cooperation; integrated logistics support (ILS); manpower and personnel integration (MANPRINT); equipment training; fielding; product assurance; total quality management (TQM); production engineering; safety; security; test and evaluation; maintenance; legal support; materiel management; engineering support; and configuration management.
- The provision and receipt of functional support affects the financial management responsibilities of both the MSC commander and the PEO/PM. The functional support provided by the MSC includes all programmatic and related efforts.

PROVIDE DEVELOPMENT & ACQUISITION SUPPORT TO PEOs/PMs

- Direct Functional Support to PM Offices
- Provide General Functional Support
- Procure, Produce (ILS) Software Engineering
- Provide Infrastructure to Support Mission

DEFINE, DEVELOP & ACQUIRE SUPERIOR TECHNOLOGIES

- Basic Research
- Industry Research
- Exploratory Development and Testing
- Support PEOs/PMs
- Provide for Research Infrastructure

• The PEO/PM is responsible for system programming and budgeting.

• Effective and efficient provision of functional and administrative support requires thorough coordination between the PEO/PM and the supporting MSC to identify and plan for support requirements. A support plan is jointly developed and negotiated between the MSC and each PEO and individual PM before the start of the fiscal year. The support plan contains the requirements of the PEO/PM for the year and the MSC commander's plan for providing the support. The plan is reviewed at least quarterly to ensure that changes in support requirements have been accommodated and to ensure the changes have been implemented.

The PEO system is clearly a responsibility partnership between the PEO/PM and HQ AMC/MSC and between HQ AMC and the AAE. Paramount to success in this system is the close, continuing, and parallel working relationship among PEO, PM, AMC, U.S. Army Training and Doctrine Command (TRADOC), and the AAE on all aspects of materiel system acquisitions throughout the life cycle. Participatory management is the modus operandi. The matrix structure allows AMC to provide effective functional support to the PEO/PM in a period of sharply declining resources.

Acquiring Superior Technologies

AMC's third RD&A mission is to define, develop, and acquire superior technologies to ensure that technology will continue to be a strong deterrent force for this nation. Support to the Army of the future begins with careful selection and management of technology.

A healthy technology base is now the centerpiece of AMC's research, development, and acquisition strategy — a strategy designed to retain and increase our technological edge on the battlefield. While the Army has slowed the pace of modernization, there is a need to make a sound investment for tomorrow's soldier. The Technology Base Master Plan and Technology Base Investment Strategy are designed to do just that; the planning, programming, and budgeting process is beginning to reflect that commitment.

A productive technology base, in and of itself, sends a message to potential adversaries anywhere in the world and at any level of conflict. The message is that this nation is committed to a strong and ready force as far into the future as one can look. The Army is trained and ready today and will be trained, ready, and even more capable in the future. This is deterrent power, and that's the message the technology base must send throughout the world.

How does AMC accomplish this mission of acquiring superior technologies? Given the pace of technological development in both the private and governmental arenas, how does AMC manage technology? AMC manages the technology base primarily through a dual-hatted general officer who is both the commander of the U.S. Army Laboratory Command (LABCOM), headquartered in Adelphi, MD, and the deputy chief of staff for technology planning and management at HQ AMC.

Within the AMC RD&A structure, the three key organizational elements responsible for the technology base efforts are the LABCOM laboratories, the research, development and engineering (RDE) centers, and the Army Research Office. The technology base resides, in part, in a complex of seven laboratories engaged in research, exploratory development and demonstrations of technologies that have broad potential for many weapon systems.

In addition to the laboratories, each of AMC's commodity commands has its own RDE center that focuses on those technologies directed at its particular products (e.g., missiles, tanks, aircraft, communications equipment, troop support equipment and armaments, including munitions and chemicals). The RDE centers and laboratories work together as a team in technology application.

The Army Research Office works with academic institutions in the areas of basic research and exploratory development. These cooperative efforts focus on the fields of physical and engineering sciences, materiels sciences, geosciences, biology, and mathematics. In addition, several universities have been designated as centers of excellence and are engaged in basic research into areas of critical importance to the Army (e.g., Cornell University is so designated for mathematics; the University of Texas and the University of Pennsylvania for artificial intelligence; and the University of Arizona and Rochester University for optics).

Out of AMC's total annual technology base budget of approximately $900 million, nearly 70 percent is devoted to work performed under contract by the nation's high-technology companies and academic institutions. AMC's scientific

community has a profound influence on the direction of future technology development in the nation, whether through contracting, information sharing or cooperative programs.

The relationship between AMC and industry is key in developing technology. AMC maintains close contact with industry through industry's own independent research and development (IRAD) programs. LABCOM plays a key Army role in maintaining cognizance of and evaluating all relevant IRAD programs. By sharing information and using technological advances cooperatively, AMC reduces duplication of effort and helps to ensure a more rapid transition of technology into Army systems.

In addition to their efforts with industry, the Army and AMC are working closely with other agencies in numerous technological areas, including directed energy, very high-speed integrated circuits, and materiel technology.

A key contributor is the Defense Advanced Research Projects Agency (DARPA). This DOD-managed organization is in the high-risk, high-payoff business and can be looked at as a venture capital organization. Current areas of mutual interest and sharing include armor/antiarmor research, laser technology, advanced computing technology, and advanced materials.

AMC is also working closely with the Department of Energy laboratories through joint programs in antiarmor research, computational mechanics, insensitive munitions, materials, and directed energy. Joint venture partnerships with other services, defense agencies, industry, and academic institutions offer ways to capture superior technology and put it to work.

For the near term, today's battlefield concerns drive the technology base. Given the richness of technological development in this country, perhaps the greatest challenge AMC faces in managing the technology base is the allocation of a limited amount of resources against what seems to be an unlimited number of demands. There are simply more technological opportunities than AMC can afford to exploit — technological opportunities such as artificial intelligence, robotics, directed energy, biotechnology, and advanced signal processing. More important, the rate of change in technologies — and the introduction of technologies that have not previously been considered by the Army — provide some unusual opportunities to develop new battlefield capabilities.

It is interesting to note that the Board on Army Science and Technology, under the auspices of the National Academy of Sciences, is conducting a two-year study of the kinds of technologies the Army might want to tap for the soldier of the future.

The Army must choose the technologies it will pursue into the next century, decide which specific technologies are ready for application to today's weapon systems, assess critical barriers to technology and then design programs to remove those barriers. LABCOM has developed an investment strategy and a technology base methodology that guides these decisions. It balances near term needs and potential future developments.

A key element of the Army's current investment strategy is the allocation of approximately 50 percent of its work and dollars to what are called "next generation and notional" systems — those systems that will begin full-scale development in the mid and late 1990s and those that follow. AMC's focus and efforts are generally based upon the needs or deficiencies of the user (usually represented by TRADOC).

One-quarter of the technology base program focuses on institutional needs such as analytic and computational requirements, and on long-term chronic problems, including corrosion, producibility, and logistics.

The remaining 25 percent of the program is dedicated to exploiting emerging technologies which may have a great impact on the battlefield, although they are not at present identified with particular weapon systems. The Army has war-gamed the impact of the notional systems on the battlefield of the future. Insights gained pointed the way to additional levels of wargaming, with more detailed examinations of such technological efforts as tactical space systems, directed energy, and the full range of robotics concepts.

Such efforts help ensure that AMC's focus on emerging technologies is consistent with the Army's increased emphasis on long-range strategic planning. It also helps ensure that the future Technology Base Investment Strategy is linked to the user's vision of warfare in the year 2015. With this forward-looking approach, AMC wants to leverage affordable technology to enhance total force effectiveness, while maintaining a strong technology research base.

In a related effort, to ensure that technology will continue to be a strong deterrent force for this nation, AMC established the Field Assistance in Science and Technology (FAST) Program. The FAST program links operational forces with AMC's laboratories and RDE centers. Scientists and engineers serve as advisors to senior Army commanders throughout the world, taking part in training and readiness activities with soldiers. There are presently 17 such science advisors. Program goals include rapidly identifying and resolving technical problems in the field; obtaining information on long-term technology, materiel needs, and problems; and, establishing a direct technical information loop between the field and AMC.

This program has been very successful. Through their computerized network of laboratories and RDE centers, AMC-FAST science advisors are finding innovative solutions to current Army field problems. As examples, the new limp-home capability for the Abrams tank rectified inherent fuel shutdown problems and allowed tanks to move off the battlefield even after critical damage to the electrical system; "Jumppack" allows soldiers to parachute with the one-man Stinger air defense missile, saving critical time on the battlefield; and, "Cyclops", a television camera with infrared capability, was deployed on the DMZ in Korea for day or night surveillance.

Current projects range from those designed to support Arctic forces (skis for howitzers) to those designed to provide materiel for low intensity conflict in tropical regions (e.g., corrosion control). Whether it is providing the latest technology to resolve current Army field problems or ensuring the Army's technological edge on the battlefield of the future, this AMC mission of defining, developing, and acquiring superior technologies is an important one to the Army.

Maintaining and Mobilizing Capabilities

AMC's fourth RD&A mission is maintaining the mobilization capabilities

MAINTAIN MOBILIZATION CAPABILITY (RD&A ASPECTS)

- Maintain Viable Industrial Base
- Advance State of Art of Manufacturing Technology
- Maintain Industrial Modernization Incentives Program

needed to support the Army. The Army acquisition process is not limited to delivery of equipment to soldiers in the field. It also includes planning for a cost effective and responsive industrial base to serve as the source for materiel those soldiers might need under changing world situations. This mission goes beyond the layaway of manufacturing plants and equipment or the preparation of planned producer agreements. It is an integral part of each phase of the acquisition life cycle.

Planning begins with research and early development work in the technology base programs. An emphasis on production as the ultimate goal of the acquisition process will encourage the development of state-of-the-art manufacturing processes in close parallel with the development of the product. In addition, manufacturing science projects can be used to bring technology advances directly back to the factory floor.

During the system development phases, the producibility, engineering and planning efforts will ensure that the multi-disciplined design team considers each proposed design alternative in light of its impact on how readily the end item or component can be produced and how manufacturing processes evolve with the ever-maturing product.

For those barriers to manufacturing productivity which transcend individual systems development, the Army Manufacturing Technology Program provides resources to improve the state of practice for U.S. industry through its technology thrust areas. This emphasis on production during the development process ensures a smooth transition between life cycle phases. In addition, it adds to the mobilization capability of the industrial base by not only ensuring that the design matches the capabilities of the base, but also advancing the base to match the evolving technologies.

This total commitment is further enhanced by making proof of production part of the development phase. Hard tooling is required for the fabrication of initial models to be used for technical and user tests, initial data to establish process control for full rate production is collected, and configuration audits of the physical hardware are conducted against available technical data packages. The result is a robust system design and industrial base capable of producing it.

Where there is insufficient or inadequate industrial capacity to support materiel requirements of the Army, the Industrial Modernization Incentives Program (MIP) can provide initial resources and business agreements to encourage capital investment by the private sector to improve their manufacturing facilities.

The mobilization capability also includes government owned facilities which manufacture, repair, and rebuild Army equipment. Depots, arsenals, and ammunition plants, along with the government owned equipment in privately owned facilities, must be ready to respond to demands for increases in materiel required to meet any threat to this nation's security. To meet this challenge, outdated and inefficient equipment must be brought into the 1990s and a cadre of skilled workers maintained to perform the kinds of tasks that are not appropriate for the private sector. Investment in such capability also will help accelerate the reaction time of private industry through direct transfer of skills and experience.

This philosophy which requires considering the industrial base as part of the total acquisition strategy serves as the common denominator for the three other RD&A missions described earlier and reinforces the deterrent characteristic of the active forces with ready mobilization capability.

Conclusion

Acquisition of materiel to support the Army is the mission for which AMC has been best known. It is a mission AMC will continue to perform in the future. As outlined herein, AMC has four broad and complex acquisition related missions to perform. These individual missions collectively constitute the RD&A mission that is critical to the Army's ability to develop and acquire the materiel the American soldier will need to fight and win on the battlefield.

Editor's Note: The preceding article was initially published in Military Technology Magazine, issue number 3, 1990.

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LOW OBSERVABLE TECHNOLOGY

By BG(P) Malcolm O'Neill
and LTC Paul Fardink

Introduction

A majority of people think that low observable technology always means something expensive and technically exotic, such as "invisible aircraft." Actually, it can also include using a moderate level of technology to gain a moderate increase in survivability at a reasonable expense. Low observable technology is a set of concepts with a shared objective: to reduce the tell-tale signatures our combat systems emit, making them more difficult to detect and engage by the enemy.

The Army specifically defines low observable technology as technology related to the reduction of radar cross section, infrared signature, acoustic and visual cues, or other signatures for system detection and tracking. This article examines the implementation of this critical technology in our combat systems, including various signature sources and their potential for reduction and trade-offs necessitated by program management cost decisions. Let us begin with the inherent philosophy.

Philosophy

Mission effectiveness of a combat system is a function of both lethality and survivability (Figure 1). Survivability is both susceptibility reduction

Author's Note: The programmatic and technical details of low observable technology and its application to specific military systems remain classified. For that reason, this article is general in nature, and all reference to specific technical information has been purposefully omitted.

[redacted]

ME= MISSION EFFECTIVENESS

P(S)= PROBABILITY OF SURVIVABILITY

E(W)= MEASURE OF LETHALITY

$$P_S = 1 - (P_H)\,(P_{K/H})$$

P_H = PROBABILITY OF A HIT

$P_{K/H}$ = PROBABILITY OF A KILL GIVEN A HIT

FUNCTION (SUSCEPTIBILITY REDUCTION)	FUNCTION (VULNERABILITY REDUCTION)
TACTICS MANEUVERABILITY/AGILITY	DAMAGE TOLERANCE
LOW OBSERVABLES (SIGNATURE REDUCTION)	COMPONENT REDUNDANCY
EXPENDABLES CHAFF/FLARES	COMPONENT LOCATION
SMOKE/DUST OBSCURATION	COMPONENT SHIELDING
DECOYS	COMPONENT ELIMINATION
THREAT WARNING	ETC.
JAMMERS	DAMAGE RESISTANCE
	PASSIVE DAMAGE SUPPRESSION
	ACTIVE DAMAGE SUPPRESSION

Figure 1.
Mission effectiveness is a function of lethality and survivability.

(preventing the hit) and vulnerability reduction (surviving the hit). Low observables reduce the probability of a hit through signature reduction. Put another way, we shift the signal-to-interface ratio in our favor by reducing the signal, whether it is radar, infrared, visual, acoustical, or something else.

Another option is to enhance interference, making use of environmental clutter which occurs naturally, such as electronic noise generated by the sensor itself or man-made interferences induced by decoys and jammers. Since our Army normally operates in a high clutter environment, even moderate levels of signature reduction can have significant payoffs.

Many people think that low observable technology applies only to detection. In reality, low observable technology applies anywhere within the engagement chain of events leading to the ultimate demise of the target: acquisition, identification, tracking, ranging, fuzing, and kill. Completely breaking any link in this chain is unrealistic. However, we can reduce the effectiveness of each link. In addition, since expense often prohibits concentrating all our efforts on breaking a single link, materiel developers have discovered that the same result is possible in a more cost effective manner by spreading resources all along that chain.

Full understanding of the target engagement chain of events mandates a discussion of the four principal signatures and an outline of the variables which can be manipulated to reduce the signal or increase interference, starting with radar.

Radar

Radar is the most effective tool ever created for detecting moving targets. It has a multitude of uses from early warning and identification to tracking and homing, which all work on the same principles. Simply stated, a target's signal ("echo" return to the radar receiver) is measured in terms of its radar cross section (RCS), a numerical value signifying the amount of electrical reflection returned from the target.

Thus, changing this signal (RCS) enhances low observability. First, we can reduce or alter the RCS by manipulating certain variables in the basic descriptive equation for radar energy. These variables are frequency, phase, polarization, absorption, and shaping, the last two being the most practical for manipulation.

Figure 2 shows the effects of various shaping concepts upon the signature level as a function of the azimuth viewing angle. The suggestive plot for the traditional design is seen to exceed the threat radar threshold level for a great percentage of the possible azimuth

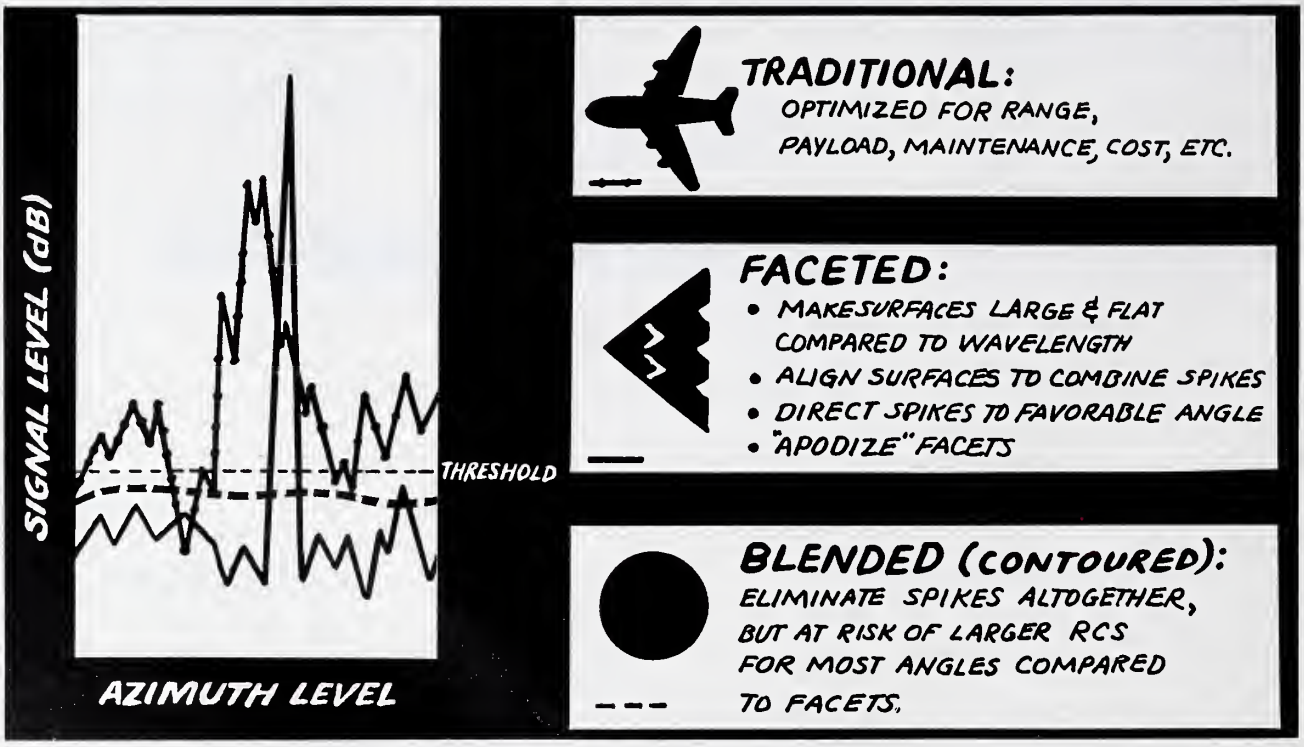


Figure 2.
The Effect of Various Shaping Doctrines on the Angular Profiles of Radar Cross Sections.

angles. The thrust of low observable technology shaping efforts is to reduce the target signature so that across most of the azimuth profile it is below the radar detection threshold. Two extreme approaches, the faceted design and the blended (contoured) design, are readily apparent in the figure.

Next, radar absorbing material (RAM) can reduce the signal a target puts out. An absorbent surface has propagation characteristics that match closely those of air, allowing at least some of the signal to enter at the interface of the surface and the air. Once inside, the electrical and magnetic characteristics of the material determine the rate of absorption and the specific wavelengths absorbed. If the desire is to operate over several frequencies, several layers may be combined.

RAM can be used in radar absorbing structures (RAS), radar absorbing coatings (RACO), radar absorbing paints (RAP), etc. The choice will depend upon its specific application.

Infrared

An examination of modern air-to-air and ground-to-air warfare between 1975 and 1985 reveals that of all the world's aircraft shot down (approximately 150), a full 93 percent can be attributed, wholly or in part, to infrared (IR) guided missiles. Radar signature reduction efforts seem to have enjoyed the priority in past years, but infrared technology is quickly closing the gap.

Infrared energy comes from a number of sources: engine heat, friction with air molecules, heat from exhaust, direct sunlight on the vehicle's skin, and sunlight reflecting off the ground (Figure 3). Infrared sensors work by measuring the release of heat from emitting hot surfaces and reflected infrared energy from the reflecting surfaces.

Many heat-seeking missiles work by tracking, not the entire vehicle, but the hottest part of the vehicle, in this case the skin around the engine. Sun glint from the reflecting surfaces is also a potential source of IR radiation for IR missile seekers.

Again, avoiding the use of equations and a detailed technical discussion, there are basically two ways to defeat the enemy's infrared sensors: The first is to reduce temperature by minimizing the amount of heat created. The second is to reduce emissivity. Basically, this means that the same amount of heat is created, but the amount emitted is reduced or the efficiency of its emission is also reduced.

Military applications to reduce the infrared signature include replacing the highly emissive paint on vehicles with low-emissive coatings that reduce the release of heat energy from the vehicle's skin. Better yet, we might apply several coatings, each with a different level of emissivity, that act like infrared camouflage. Temperature control itself offers the greatest potential for signature reduction. Techniques include cooling of the engine's hot metal parts and the exhaust plume through the use of blowers, mixers and suppressors.

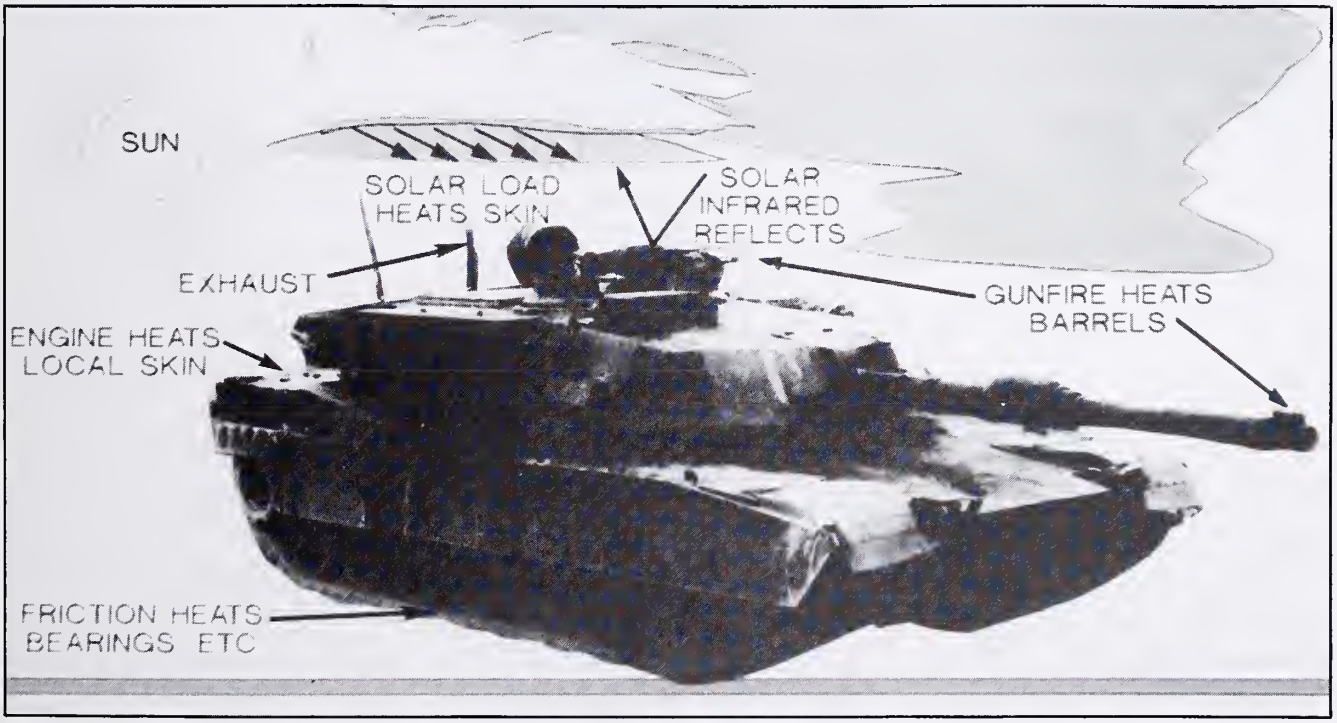


Figure 3.
Armored Vehicle IR Energy Sources.

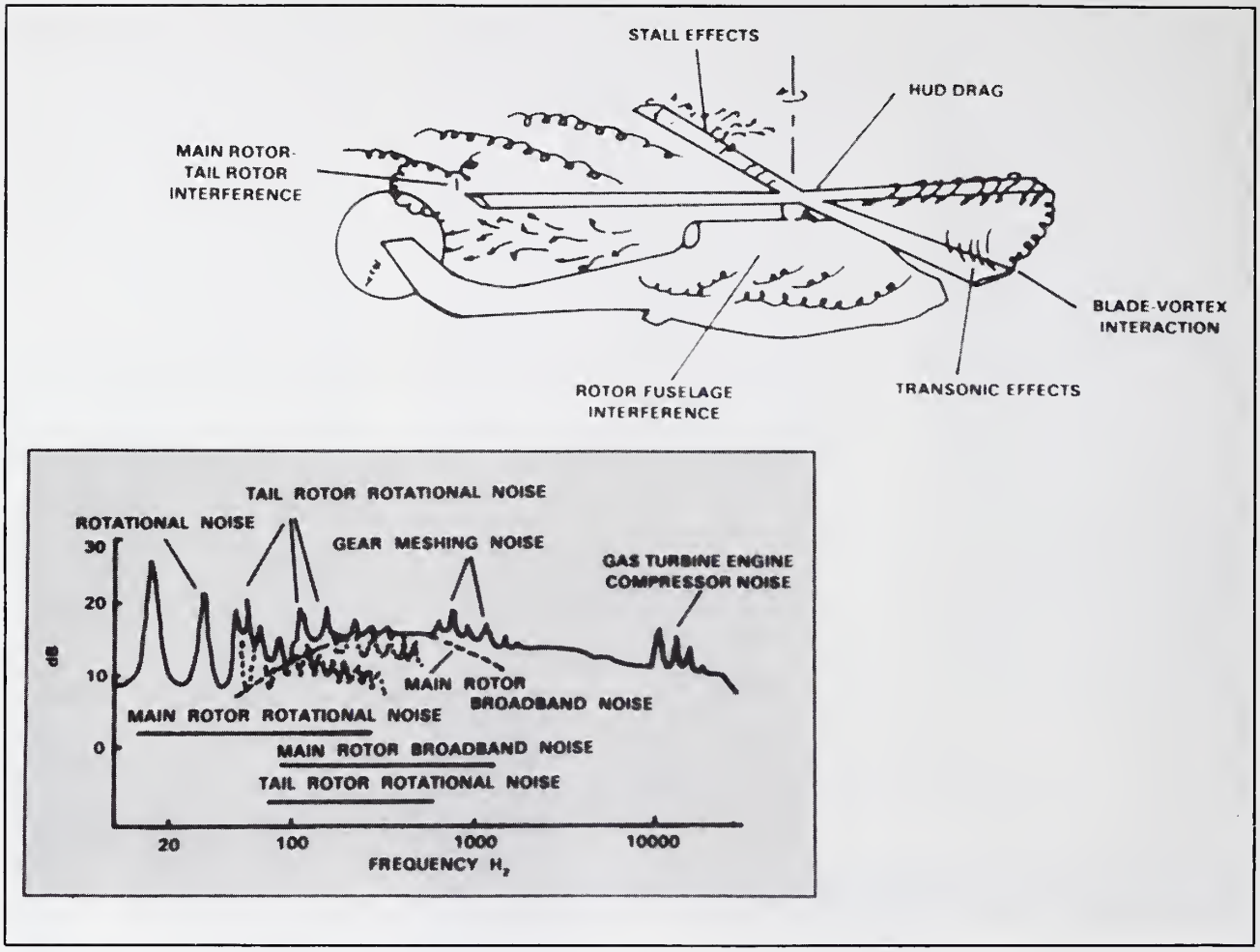


Figure 4.
Generic Noise Signature of a Helicopter.

Acoustics

The technical debate rages on regarding whether the accuracy of position determination using acoustic sensing is sufficient for fire control. What is important here is the fact that acoustics is an excellent tactical non-line-of-sight detection option. The long wavelengths associated with acoustics, as well as atmospheric, ground, and reflection propagation effects, allow detection of targets even when they are hidden behind large objects such as hills and other terrain features.

Figures 4 and 5 depict the various sources of acoustic emanations from a rotary wing aircraft and from a ground combat vehicle. Among these for helicopters are engine noises, fuselage vibrations and several emissions from the main and tail rotors. For armored combat vehicles these include engine noises, track suspension noise, track squeal, etc.

In the acoustic spectrum, the high amplitude, low frequency emissions propagate further than the high frequency components which tend to attenuate as they pass through the atmosphere.

To reduce acoustic signatures then, several options are available. In the cases of turbine engines and properly muffled piston engines, low frequency emanations can be kept to a reduced level through good muffler design and encasement of high noise level components in absorbing compartments.

Redesign of components such as the "tuning fork" design of the track guide will reduce track squeal. Cures for the helicopter include approaches to controlling blade-vortex interactions by avoiding certain flight profiles, slowing rotors to reduce turbulence, and redesign of rotor blade tips.

Strategies for reducing tail rotor noise might include removing the tail rotor altogether by substituting for its torque control the use of side-directed jet air flow, an imbedded side directed fan, coaxial counter rotating main rotor blades, and changing the tail rotor blades angular separation.

Visual

Visual threat sensors will be used against us for years to come.

For example, even the Soviet's newest and most sophisticated anti-air missile systems depend on visual back-up for their radar operations. Optical devices are found in every step of the target engagement process. The human eye is

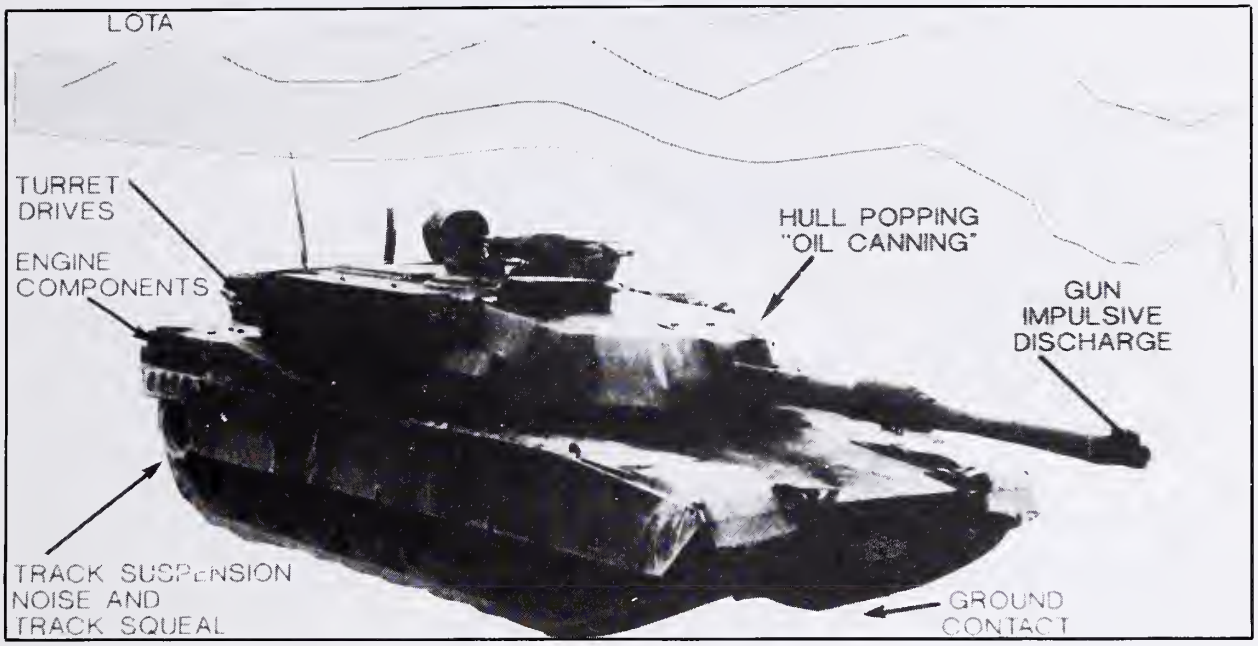


Figure 5.
Generic Noise Signature of a Tank.

extremely good at motion detection, pattern recognition, color, contrast, and depth perception. This is due in part to the fact that light energy has very short wavelengths which allow for the discernment of fine detail.

In the visual spectrum, the variable we can manipulate depends on whether the source is radiate, such as headlights and landing lights; or irradiate, such as reflected sunlight or artificial light. Controlling visual signature by controlling reflectivity, more commonly known as camouflage, includes a broad set of interference enhancement techniques designed to confuse the threat sensor. Among the most practical are control of pattern and contrast. Today's various paint schemes on our vehicles and battle dress uniforms (BDUs) attempt to do this.

As stressed earlier, a multi-spectral approach is necessary here to balance priorities. For example, high reflection in the visual region does not imply high reflection in the infrared region. White paint will be very absorptive in the infrared and the ultraviolet solar portions of the spectrum.

Trade-Offs

One might ask about the military effectiveness of low observable ground equipment if it can be detected by the dust clouds it stirs up. . .or the validity in implementing approach tactics that reduce acoustic detection but also reduce an attack helicopter's ability to fight.

Obviously, if the Army is to implement low observable technology, certain trade-offs must be addressed. For maximum effectiveness, we must consider four trade-offs: how to mix low observable treatments, establish their priority, compare the costs, and, above all, consider what level of low observability is simply enough.

Determining the correct mix of low observable technology requires that we consider all the treatments being proposed. The threat may be able to detect us more effectively in one sensor region than in others. We might choose to devote most of our effort to diminishing this signature, with supplemental treatments for the rest of the mix. Mixing treatments must be performed carefully, however, since work on one region may affect the others.

Furthermore, determining the priorities for low observable treatments is accomplished by a quantitative assessment of the importance of each mission and where we are in the threat engagement process (acquisition, track, fuze).

The type of sensor region we are operating in, as well as the specific characteristics of a threat weapon system, is likewise a salient factor. The program manager must also assess the risks involved because if the chances for achieving the top priority are risky, he

Low observable technology can help the Army find new, less expensive ways to keep our forces fighting against an increasingly sophisticated threat sensor and weapon array that the technology of modern warfare has placed not only in the hands of our major adversaries but in third world countries as well.

may prefer to spend his limited money on a lower priority for which success is more likely.

Determining the minimally adequate level of signature reduction applied to Army systems to prevent the threat's success is crucial. Determination of "how much is enough?" starts by assessing intelligence data with regard to the level of signature threat sensors required to engage a target and by assessing our ability to apply signature control. Taking this information initially through computer analysis and then through small proof-of-concept technical demonstrations offers the program manager a critical design point process where he can choose what level of low observables to apply.

Cost, today more than ever, is a crucial concern! To appreciate its full impact, we must consider how low observables fit into the entire engagement process (as defined earlier). Concentrating all efforts to break a single link (acquisition) in the process can be prohibitively expensive, but if resources are spread along the chain (identification, engaging, tracking, and fuzing), we can achieve adequate survivability in a more cost effective manner.

Summary

Application of low observable technology can be a complex matter.

Careful thought must be given to balance low observable technology with traditional survivability enhancement approaches to achieve system survivability, not just low observability. The major subordinate commands of the Army Materiel Command are all taking a harder look at low observable technology and its application to combat systems.

The Army's Technology Base Master Plan has identified low observables as one of its 13 critical emerging technologies. As the cost of our combat systems continues to rise, it makes good sense to make them as survivable as possible.

Low observable technology can help the Army find new, less expensive ways to keep our forces fighting against an increasingly sophisticated threat sensor and weapon array that the technology of modern warfare has placed not only in the hands of our major adversaries but in third world countries as well.

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AVOIDING TECHNOLOGICAL OBSOLESCENCE IN ACQUIRING C^3 SYSTEMS

By Richard G. Howe

First, it's fair to say that the defense acquisition process is not functioning as well as anyone of us would like. Whether correct or not, there is a perception among many that all of us involved in the RD&A business are doing a poor job. This is because too many programs come in late, are over budget and, to make matters worse, often don't meet their stated operational and technical objectives. To make this situation even more troublesome, the whole research, development and acquisition process associated with these programs generally takes too long.

Some recent studies have shown that by strictly following the existing acquisition process, it could take more than 20 years to go from identifying the need for a new system to initial deployment of the system. In an era when technology is doubling every several years, we can't afford to wait one decade, let alone two, to field new systems — particularly command, control and communications (C^3) systems. If we continue to do this, we can guarantee ourselves and the user that the C^3 systems we field will be technologically obsolescent and may not be what the user really wants or needs.

To avoid technological obsolescence in C^3 systems, the RD&A community must be more conscious of time. The existence of computers, automation, micro-electronics, etc., practically guarantees us that those C^3 systems we do field will provide a marked improvement over those manual, vacuum-tube systems of the 1960s. However, should we be satisfied with fielding the technology of the 1970s and early 1980s in the late 1990s and yes, the year 2000 and beyond?

Apparently, there are those in our community who see nothing wrong with a 20-year-plus acquisition cycle to field new radios, telephone switches, multiplex equipment, command and control decision aids, etc.

Programs such as the Joint Tactical Communications System (TRI-TAC), Single-Channel Ground and Airborne Radio Subsystem-VHF (SINCGARS), Tactical Air Operations Module/Modular Control Equipment (TAOM/MCE), WWMCCS Information System (WIS), Army Data Distribution System (ADDS), and Advanced Field Artillery Tactical Data System (AFATDS) all have the common denominator of simply taking too long from the requirements definition phase to the fielding of hardware.

Space doesn't permit examining each of these programs for the root causes, but suffice it to say that in most of the above examples cited, we are in fact fielding technology that may have seen its better days.

The immediate defense mechanism is to say, "It's much better than anything else in the field today so why not go with it!!" The response to that can be in most instances — "Yes, but we could have fielded that capability five to 10 years ago if we had adhered to the original system requirements and used an evolutionary acquisition (EA) approach (see Figure 1) as we moved along." Instead, we continuously delayed development and acquisition by continuously redefining the requirements and starting over again.

Without trying to pass specific judgment on the program examples cited above, let's examine some decisions that are necessary if we are to avoid fielding obsolescent systems.

The RD&A community must involve the user throughout the RD&A process. We can not simply take a requirements statement from the using community and disappear until it's time for the user operational test and evaluation. Unfortunately, the graveyard of programs is littered with those systems which took too long to develop and by the time they

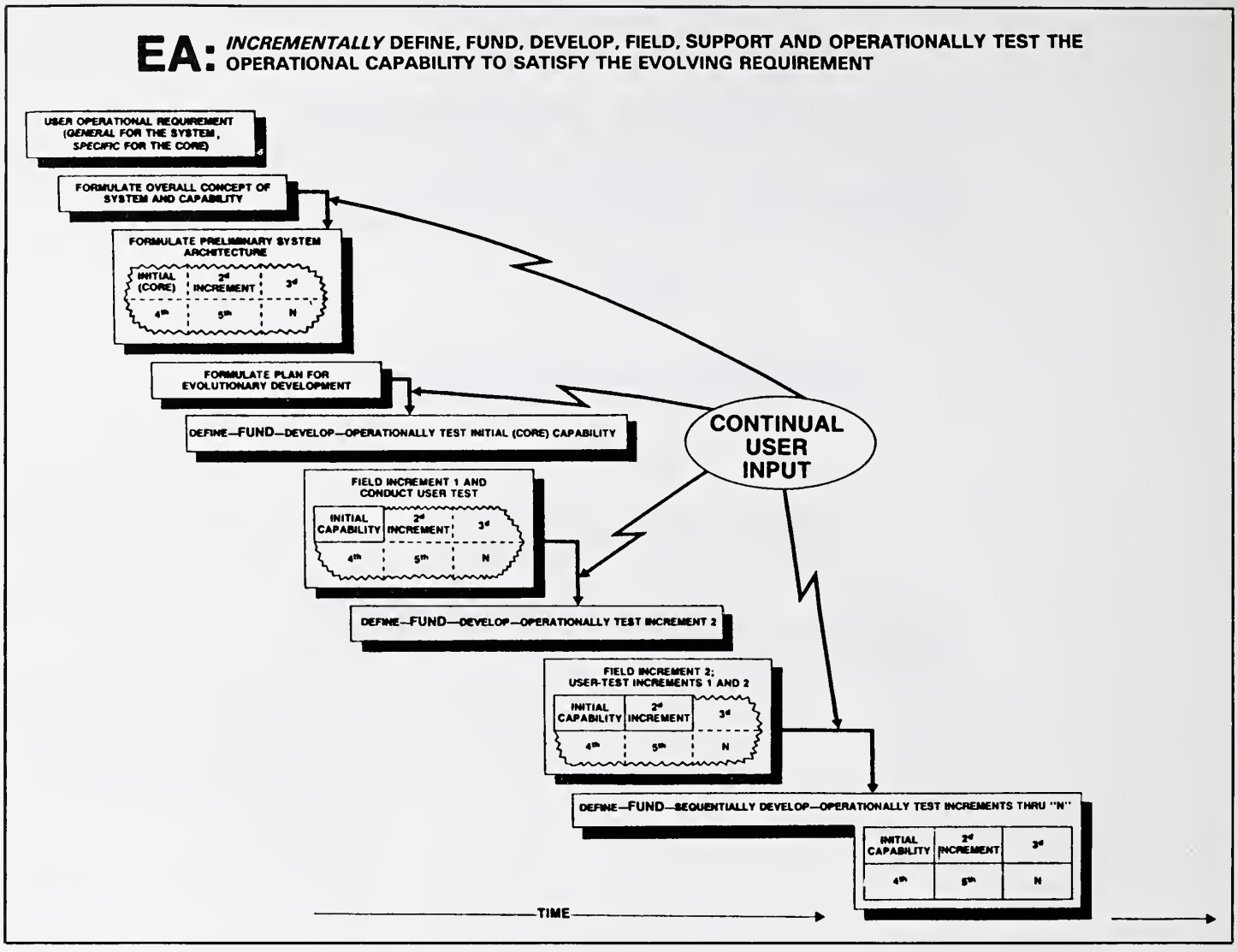


Figure 1.

were ready to test, were not what the user wanted in the first place.

The dialogue between the user and the RD&A community must be continuous. We must both agree (particularly with software intensive C^3 systems) on a baseline or core system as the initial "*fieldable*" objective. Then, we must discipline ourselves to stick with the core system and get it developed, tested and fielded. As we continue with the development of the core system we must start our planning for the next increment or upgrade(s) based on lessons learned from the core system and the further delineation of the user requirement and changes in doctrine.

Many of our program "failures" have resulted from unnecessary, expensive and time-consuming engineering change proposals (ECPs) which the developers (industry and government) became enchanted with but then simply resulted in more time being taken to get an improved capability to the field. Again, with this additional time for system development because of extensive ECPs we become vulnerable to the charge of fielding somewhat obsolescent technology when all is said and done.

Much has been said and written about the use of non-developmental item (NDI) or so-called commercial off-the-shelf (COTS) equipment acquisition strategy. A growing community believes that new and improved C^3I systems, in many cases, easily lend themselves to this acquisition strategy. The obvious benefits are that we can field improved capabilities in a much shorter time and take advantage of existing and available technology immediately without the danger of it becoming obsolescent during an extended development cycle.

The downside is that some of the NDI or COTS equipment do not meet all of our military requirements and may not result in any battlefield advantages since they theoretically are available to both sides. However, as COL W. H. Freestone, Jr. indicates in his article "The Copernicus Syndrome," Nov-Dec 1989 *Army RD&A Bulletin*, "Both of these acquisition methods (NDI/COTS) sound like a sensible way to deal with the problem of system obsolescence, while at the same time saving money, since off-the-shelf purchases would tend to provide opportunities for volume purchase of any products that already exist." Let me add that a very tangible benefit is the real possibility of avoiding a lengthy

and costly development process which in itself may not result in significant gains in either capability or technology.

A good C^3 case in point here is the Army's procurement of the Mobile Subscriber Equipment System (MSE). While the MSE system that is being fielded today does not have all the capabilities that the Signal Corps would have liked, it will provide a C^3 capability far superior to anything that exists today, it will avoid a costly (estimated $400- 700M) and lengthy (7-10 years) development cycle and essentially will field today's technology today.

Yes, the MSE acquisition managers intend to eventually make product improvements. The key here, however, is that the fielding of MSE is not being unnecessarily delayed waiting for the "next, great, etc." improvement.

In addressing the subject of technology, the concepts of so-called evolutionary acquisition (EA) and preplanned product improvements (P^3I) as acquisition strategies must also be discussed. Evolutionary acquisition is a strategy designed to provide an early, useful capability even though detailed overall system requirements cannot be fully defined at the program's inception.

The decision to follow an evolutionary acquisition strategy can be made at Milestone 0 or I. This involves the acknowledgement that requirements will evolve during the acquisition life of the program and that both the technical architecture and programmatic structure of the procurement will be designed to accommodate this growth.

In the early stages of C^3 system acquisition (concept development), neither the system user nor the system developer may be aware of or fully understand what technology can eventually bring or what user changes will be needed to the final objective system under consideration. This should not be cause to keep the system continually in the development phase until all the great leaps in technology and all the user changes are abundantly clear. Rather, we should attempt to develop so-called well-defined core systems and get them into the hands of the user as soon as possible. At the same time, we (the user and system developers) can begin to assess the possible "improvements" or increments to the system as hardware and software technology and doctrine advances and matures.

In many instances, these improvements can be identified well in advance of fielding, but, because of likely program delays and increased cost, we may choose not to implement them. Other improvements and changes may be either vague or beyond our immediate technological capability, and we should choose to place them in future increments of our EA or P^3I cycles.

In summary, the concepts of evolutionary acquisition or P^3I must be integrated into those C^3 system acquisition strategies where they make sense and when they can be used to avoid C^3 system obsolesence.

In spite of the fact that many of our current acquisition regulations imply that the manufacturer should solely determine most technology decisions in systems development, I submit both the user and the government RD&A community must be closely involved. This certainly doesn't mean that the government should specify in detail every technological aspect of the C^3 system under consideration. However, the user and the program manager must be intimately aware of the effect technology may have on the operational and technical performance of the system. Additionally, the user and program manager must also assess the effect that technology has on cost, schedule, and integrated logistics support. As COL Freestone suggests in his article, if this is done at all today, it's on an "ad hoc basis." The issue here is perhaps cultural, if so it is time for a much needed change in our culture.

While we have been primarily addressing technology and its impact on systems development and acquisition, we should also mention that system operational concepts can also become obsolete if the development cycle for the system takes too long.

It is doubtful that the majority of C^3 operational and doctrinal concepts will ever change as fast as the associated hardware and software technology. However, there are examples of failed systems where the development time took so long that the system could simply not meet the changed operational requirements which had outpaced the too lengthy development cycle. This is not to condone the continuous changing of requirements once system development is underway.

Certainly, once the development contract is signed, the extensive changing of operational requirements must be discouraged or delayed to future increments. It is unreasonable for the developing community to expect no change at all if a system takes excessive development time. Suffice it to say that undisciplined system definition has allowed contracts to be awarded for developing C^3 systems whose specifications were insufficient and whose characteristics were ordered changed while the system was being built. This situation is certainly a recipe for disaster.

Recently, the secretary of defense announced the results of the Defense Management Review (DMR) which, in part, is aimed at reforming the acquisition process. One obvious goal is to significantly shorten the time it takes to develop and field new systems. This will require eliminating the "business as usual" approach and involve new innovative ways to acquire systems. Don't be surprised to see numerous acquisition directives and regulations changed or eliminated as well as layers of existing organizational bureaucracy.

Avoiding technological obsolescence demands that we change some of our thinking in acquiring C^3 systems. The entire system is not broken and we probably do not require major repair. However, the changes we need to make to avoid the troubles of the past will continue to face resistance to change and parochialism.

With the strong emphasis today on acquisition reform, the time is ripe for the C^3 RD&A community to lead the way in innovation, effecting cultural change where necessary, and establishing better relationships with the user community and industry while introducing the concept of evolutionary acquisition. We must provide the highest quality product that performs its intended function — on time, on cost and one that offers the user the best technology available.

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THE ARMY WARRANTY PROGRAM

Is It as Good as Your Car Warranty?

By Taras J. Galysh

Prior to 1984, the use of warranties for major weapon systems procurements within the services and the Army was not mandatory. The policy was to obtain warranties only when in the best interest of the government. The enactment of Section 794 of the Department of Defense Appropriations Act of 1984 ended this policy and required mandatory warranties be included.

Effective Jan. 1, 1985, Section 794 was repealed and new language was enacted in Section 2403 of Title 10 United States Code. This language, with minor changes from Section 794, requires the mandatory inclusion of cost effective warranties as part of the procurement of major weapon systems.

The warranty law itself is brief, to the point, and based on the simple premise that the contractor will stand behind his product. With increased emphasis on quality through processes such as statistical process control and the application of total quality management, the use of warranties is a logical extension of Army efforts to improve system quality.

This article will attempt to answer two of the most often asked questions regarding the Army warranty program: What does the warranty really provide to the soldier; and, is the program really cost effective?

The most common perception of a warranty is that normally associated with a car or an appliance. If something doesn't work during the life of the warranty, the owner either takes the item to the place of purchase, authorized dealer or repair shop and gets the item fixed or a service representative comes out and repairs the item. Despite the inconvenience of not having the use of the item while it's being repaired, this procedure seems to work. The warranty provides a relationship between the owner and the producer or the producer's representative.

Within the Army, the corollary would be that when a weapon system fails during the warranty period, the soldier takes it to the authorized repair point or to the local dealer and repairs are performed.

Within the Army, the corollary would be that when a weapon system fails during the warranty period, the soldier takes it to the authorized repair point or to the local dealer and repairs are performed. In some cases, a local service representative would repair the item on site. Well, immediately one can see a problem with this approach. This scenario is fine if the repair point or dealer is nearby. However, what happens if the local dealer is miles away or non-existent?

It quickly becomes obvious that following warranty procedures associated with the commercial market is not always applicable or executable within the framework of the support concepts of the Army. It is like the square peg in a round hole — some edges get in the way.

Even when one tries to equate the supporting maintenance unit to that authorized dealer or repairer, this entails the development of procedures for that maintenance unit to interface with the actual contractor or producer of the item. There is no direct link between the soldier and the contractor or producer.

What The Warranty Provides

What does the warranty provide the soldier if the soldier cannot get the same type of relationship with the contractor as one does with a commercial warranty?

To answer this question, one must look at the warranty coverages the Army warranty program provides. There are two basic types of coverage: individual failure coverage and systemic defect coverage. These types of coverage can be used in tandem. However, as a minimum, systemic defect coverage must be used.

Individual Failure Coverage

This coverage is almost a carbon copy of the normal car or appliance warranty with modifications to account for Army support concepts and reporting systems. As its name implies, every time the warranted weapon system breaks or fails, corrective action under the warranty provisions are enacted. A good example is the warranty for Commercial Utility Cargo Vehicle (CUCV). This means taking the CUCV to the local GM dealer for repair.

Where a local dealership is not available or the unit commander decides that for readiness reasons the vehicle needs to be repaired immediately, the repair may be accomplished by organic means and a warranty claim submitted to the procuring activity. The warranty claim would be processed with eventual reimbursement of monies from the contractor for parts and labor. These monies then go into a central Army account. Utilizing this type of coverage, the Army can have the weapon system repaired either by an available contractor or by organic support, while meeting readiness requirements and recouping reimbursement from the contractor for that repair.

Benefits from such a warranty are often difficult to see by owners of the equipment. While there is reimbursement from the contractor, the unit is required to fund for the repair of that item. Even when a local dealer is available and repair is done at no cost, this is afforded to only a small percentage of the owners. Furthermore, there are local dealers available only to a small percentage of warranted weapon systems.

While such coverage seems the simplest and easiest to understand and execute, it is burdensome upon the user. The warranted item must be identified, certain procedures must be followed, coordination with local contractor representatives performed, and possible failed items might be required to be held for return as exhibits. Additionally, the owning agency must still budget for all repairs regardless of whether those systems are covered by a warranty.

Systemic Defect Coverage

This is definitely a departure from the normal car or appliance warranty and even the individual failure coverage warranty. Under this coverage, rather than invoke a warranty remedy every time a failure occurs, the emphasis is on correcting the repetitive or systemic type of failures or product defects that most affect the performance of the weapon system. Rather than worry each time the transmission fails, the failure rate of that transmission is tracked to determine whether there is a repetitive or abnormal rate of failure to indicate a basic defect with that item.

Remedies utilized under this coverage are the basic remedies (repair or replacement, reimbursement for Army repair) for each item as allowed under the law. However, with systemic coverage, the remedy can be for production-wide or lot-wide correction instead of individual repair. In addition to this broad application of basic remedies, another remedy can be invoked. The responsible contractor may be required to redesign an item if the reason for the defect of a component, sub-component or end item is the basic design and the only way to correct repetitive failures or defects is to change the design.

The responsible contractor may be required to redesign an item if the reason for the defect of a component, sub-component or end item is the basic design and the only way to correct repetitive failures or defects is to change the design.

As with individual coverage, there are pros and cons to this type of coverage. The key to the success of systemic coverage is the ability of the Army to identify those abnormal failures or defects. Therefore, any and all resources are tapped to collect information by any of the following methods: quality deficiency reports, equipment improvement reports, supply usage data that may indicate higher than normal parts usage, sample data collection, logistics assistance office reports, program manager reports, fielding reports, and maintenance data.

While none of the above data sources by itself will definitely identify a systemic problem, each has the ability to identify potential problems that need investigation. As a whole, the data available can then be used to pinpoint the systemic or repetitive problem.

This type of warranty also places the minimum burden upon the soldier, while placing the decision process of when and what remedy to invoke with the procuring activity. Benefits, while not always immediate, are potentially greater to the Army as a whole. Not only can individual defects be corrected, but also future recurrences of such defects can be avoided.

The use of a systemic warranty coverage is viable because the Army owns the total fleet. This fleet-owner approach allows for a broader base of information from which potential defects can be identified, and the application of remedies and benefits accrue to the whole Army. Furthermore, the need for local dealerships is eliminated.

This is not to say that the use of individual failure coverage is completely ignored. In cases where a contractor is providing maintenance support for a warranted item, such warranty coverage would be feasible because the item in question is being returned to the contractor anyway. The basic criteria for the use of individual failure coverage should be cost, ability to execute, and some common sense.

Now one can see the basic differences between the car warranty and the way the Army executes a warranty. The execution of an Army warranty takes into account the Army support structure, and, specifically, the ability to repair the item within organic means. Also, rather than address each failure of a warranted item, it focuses on the defects having the greatest affect upon performance. It also recognizes that for such a warranty program to work, the burden placed upon the soldier must be kept to a minimum.

Is the Warranty Cost Effective?

While all warranties should be cost effective, the question that must be raised is: "are they really cost effective?" Is the Army really getting its money's worth? Let's look at what makes up the benefits. The most obvious benefit is what we get from the contractor under the various remedies allowed. How many items are repaired or reimbursed thru organic repair? Did

The key to implementing a successful and cost effective warranty is to identify what the government wants and what needs to be warranted, to consider the soldier owner of the item, and finally to not expect the warranty to solve all user problems.

the contractor offer any replacements for defective items? These benefits are tangible and easily identified.

However, there are other benefits that can be attributed to a warranty. Some of the most common include: insurance that the product performs as intended, liability for product performance remains with the contractor, reduction of government risk, and an overall positive affect upon product quality. The problem with these benefits is in trying to identify which benefits actually occurred.

If an item performs as it is intended, is it the direct result of having a warranty or is it because the contractor did his job well? If the warranty is never used, does it mean that the warranty was not cost effective? If you never have to take your car in during the warranty except for normal maintenance, is the warranty a bad warranty? This is the basic dilemma that is faced when someone analyzes a warranty.

Too many times only those identifiable monetary benefits are looked at, and a conclusion as to success is made. Too many times the success of a warranty is based on how much "free" maintenance the Army can receive, even though everyone knows that nothing is really "free." The key to a implementing a successful and cost effective warranty is to identify what the government wants and what needs to be warranted, to consider the soldier owner of the item, and finally to not expect the warranty to solve all user problems. Emphasis should be placed on improving the product rather than just repairing something that fails. The use of a warranty approach that identifies defects that affect the total performance of a weapon system and gets them corrected, not just now, but in future procurements, makes a warranty not only successful but cost effective.

The ultimate success of a warranty program, or any quality program, is dependent on an effective partnership between the Army Materiel Command (AMC) and the soldier. While the people involved in the warranty program are continually improving the application of warranties in order to provide the greatest benefit to the Army as a whole, without both parties fully involved the Army warranty program cannot succeed. The soldier must ensure that accurate data is provided to AMC data bases. Quality Deficiency Reports (QDR) must be submitted for defective equipment when required, and must provide accurate feedback. On the wholesale side, AMC must be sensitive to the soldier's complaints, comments and suggestions, and take corrective action in a timely and aggressive manner.

Conclusion

Is the Army warranty program as good as your car warranty? I believe it is better. Primarily because it takes a fleet approach to identifying problems, and provides remedies that can be applied not only on individual warranted items, but across the complete fleet. In this way, not only are individual problems resolved, but improvements to the overall quality of future production is assured.

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Toward a Smarter Defense...

RALLYING POINTS FOR THE 90s

Setting Two Level Maintenance as a "Technology Linking Goal"

By COL W.H. Freestone Jr.

Background

Against a backdrop of dramatic and far-reaching changes presently occurring in Eastern Europe (which amounts to a revolution), the Army is in a position today to lead the rest of DOD in a peaceful revolution of its own.

Over the past 40-odd years, the U.S. military, for the most part, has been in a reaction mode. Most of what we have done has been oriented toward keeping abreast of the threat from the Warsaw Pact and other anti-Western alliances. As a result, we have not had much time to spend on any meaningful overhaul of the process used to acquire weapon systems. There is quite a bit of interest in this now, however, with the lowering of East West tensions.

In the past, most of our activity has been to field systems which at the time of production tended to reflect technology prevalent when the Required Operational Capability (ROC) was finalized. With several years passing between a completed ROC and the fielding of a system, many subsequent advances in technology could be expected to be left out. Additionally, a project manager, bound by cost and schedule, would most likely say, "If it is not in the ROC, then we can't or won't do it."

Today, once in "concrete," so to speak, the ROC tends to reflect knowledge of technology that was "mature" and deemed ready for use during the initial concept of a system. In addition, "mature" technology — if it has been around long enough to become "mature" — is often obsolete technology

A much discussed and lengthy process is required today to finalize the development and fielding of weapon system hardware. The acquisition process, in addition to being long, continues to foster obsolescence by

The conventional force threat, as we have known it, is diminishing.

capturing, in general, only those technical ideas prevalent at the time the original ROC was written. Much hue and cry has been ongoing to try to change the process to ensure current technology reaches the field in a timely manner.

The conventional force threat, as we have known it, is diminishing. Today, however, a unique opportunity presents itself for the conventional force. This is particularly true in the face of expected changes on how the Army will be constituted in the 90s. Rather than just waiting for new missions to develop, we could take today's unique historic and peaceful opportunity to forge a closer connection between technology and the writing of Army system requirements.

Today, current planning by the Department of Defense is oriented less on fighting the "big war" and more toward preparing to deal with an uncertain future where the possibility of "regional conflicts" is expected to be more prevalent.

Rallying Points (The 70s)

During the 1970s, the Army adopted the concept of peacetime/cold war "rallying points" to help focus our collective system development energies in a common direction. The focus then was on those post-Vietnam major weapon systems deemed critical to our fighting capability, if needed, in the following decade. This forward-looking approach sought to develop a focus on systems that would facilitate an understanding of hardware that would insure our continued superiority, by capitalizing on the best that industry could provide them (within the context of the budget). The principle systems involved were known as the "big five" — the M-1 Main Battle Tank, Apache Helicopter, Bradley Fighting Vehicle, UTTAS/Blackhawk Helicopter (UH-60), and Patriot Missile. As "rallying points" these systems provided a new focus for the Army, as the nation emerged from the Vietnam era. During that time, we shifted from a theatre (Southeast Asia) orientation, back to what was referred to as a return to a "worldwide orientation." This was occurring as we prepared to continue our defense of Western Europe against a potential challenge from the Warsaw Pact.

Rallying Points (The 80s)

During the mid-1980s, as the big five major weapon systems began to enter service, a shift was made away from the development of major new systems per se and more toward improving the quality of our overall offensive capability. The new "rallying points" looked more to gains in qualitative, operational and technical performance in specific areas and were referred to as the key operational capabilities (KOC). KOCs continue today to focus attention on very broad target areas where we want to see improvements in overall combat capability. They include: RSTA (Reconnaissance, Surveillance, Target Acquisition); C3 (Command, Control and Communications); Battlefield Sustainment; Battlefield Lethality; and Soldier/Unit Performance Enhancement.

This new big five was and still is intended to sustain an Army development focus through the year 2000 and beyond. These areas do provide a good means to orient our energies on improving combat capability. However, these latest focus areas by themselves do not provide for an accompanying set of force multiplier technology based goals.

At present, with no accompanying technology-derived goals, there is no direct link between the current big five and the technical means to achieve gains in those areas. Technology that will help to provide the means to achieve significant gains in these areas might be overlooked unless there is a set of linking technology goals oriented toward bridging the gap between the world of technology and the Army system user community.

The 90s — Technology-Derived Force Multipliers

In recent years, we have heard much about the concept of "force multipliers." This is based on a recognition of a potential imbalance in numbers of conventional systems between potential adversaries in Eastern Europe and the forces of NATO. The object in seeking force multipliers has been to extend our existing conventional capability to make up for any potential imbalance on the battlefield.

There are many types of force multipliers. They range all the way from new employment tactics to new inventions, such as radar during World War II. Their inclusion in an array of a nation's weapon system capabilities could make the difference in determining the outcome of a future battle.

Today, current planning by the Department of Defense is oriented less on fighting the "big war" and more toward preparing to deal with an uncertain future where the possibility of "regional conflicts" is expected to be more prevalent. In this context the need to ease the system maintenance burden

The main point here is if fewer echelons of maintenance is deemed of overall benefit to the force, the Army could take the lead and not wait for DOD regulations to reflect an awareness of this improvement in logistics support.

is a continuing request. The suggestion here then is to take as an example that desire and need for more easily maintained equipment and examine how an accompanying technology force multiplier link may be made to the current list of "rallying points" discussed above.

A Word About Technology

Certainly one of the most, if not the most, important technology for future Army system needs is electronics. In the last few years, some truly dramatic enhancements have occurred in the world of integrated circuit development. The power of modern electronic components may enhance both new as well as old systems. But what if the Army community is not informed of these advances? Will individual managers be in a position to insure a unified approach to capitalize on these benefits?

The Troops Do What The Commander Checks

This well established and meaningful axiom, in general, concerns either verbal or written guidance to members of a military force concerning things that are important to accomplish the mission. In the context of these observations, the term "commander" refers to the regulations that govern DOD system acquisition.

One may assume that the Department of Defense, in addition to maintaining an effective fighting force, plans to "win with technology." This is evidenced by the importance that is placed on research and development during the budgeting process. Yet, in the current system acquisition process there are no measures of technology contained in the governing regulations.

So how does anyone know if they have succeeded in taking advantage of technology advances? The old hypothetical question, "If a tree falls in the forest with no one there physically to hear the event, then one may logically ask, was there a sound?" The parallel here points to the fact that with no direct questions about technology contained in DOD acquisition regulations, how do writers of requirements know what technology advances to seek? What causes them to know which advances in technology translate into a force multiplier battlefield advantage?

Adding A Technology Link

In the discussion above it was pointed out that soldiers generally desire to have more easily maintained equipment. It was also shown that one of the key technologies available to the Army today is based on the advances that continue to be made in electronics.

Today, advanced electronic integrated circuits have sufficient circuitry contained within to enable system designers to include capabilities not previously possible. Take "built-in-test" (BIT), for example. It is possible today to include a built-in-test capability "on chip" as it is referred to when it is requested by a user. A built-in "fault-isolation" (FIT) capability may also be added. A question in this regard is how many writers of requirements know that this capability exists, both for new systems as well as upgrades to old systems? Taking this capability for (BIT/FIT) as just one example, we can translate these advances in electronic integrated circuit development into a force multiplying technology link.

BIT/FIT enables a system to test internal performance for digital circuits without the need for external test equipment. If one does not need external test equipment then the need for multiple maintenance echelons might be reduced. For some systems it might be possible to eliminate maintenance echelons to just two — the field location and a facility that would repair components.

Intermediate maintenance for some components might not be necessary. The linking technology goal for the Army therefore would be to establish a link to the key operational capabilities (BIT-FIT) as two level maintenance.

Two level maintenance could help lower the logistics burden on field units. If deemed desirable, then a "technology linking goal" would help to have everyone involved in system acquisition giving it consideration.

Conclusion

The Army could set as a "technology linking goal" (to the Key Operational Capabilities) two level maintenance. The means to accomplish this now exists. The main point here is if fewer echelons of maintenance is deemed of overall benefit to the force, the Army could take the lead and not wait for DOD regulations to reflect an awareness of this improvement in logistics support. In the areas of soldier/unit performance enhancement and battlefield sustainment, a true two level maintenance capability could revolutionize system support for electronics. Who knows, with users more knowledgeable, we might even see two level maintenance show up in a ROC.

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TQM. . .Who is the Customer?

REFLECTIONS

By George

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Total quality management (TQM) is a management philosophy involving all employees in all functional elements. It is geared towards continuous process improvement so that a specific product will result in customer satisfaction. However, for the Army contracting process, who is the customer? Is it the PM or lab commander who wants his contract awarded today so he can meet program objectives and milestones?

Is the customer the procurement director who wants to satisfy the PM, but who also faces a host of Congressionally mandated social/economic goals such as competition and awards to 8A or small disadvantaged businesses? The procurement director also knows he might be second-guessed by a multitude of IGs, auditors, etc — perhaps years after the award has been made.

Or is the customer the external reviewer (IG, GAO, AAA, etc.) whose primary concern is that current laws and regulations have been complied with and who may not consider the urgency of the requirement in the after-the-fact assessment, even as a mitigating factor?

Most often in the Army, both civilians and military are told that the customer is the soldier in the field. But is he or she the ultimate contracting TQM customer? Undoubtedly, the soldier must be supported and needs timely delivery of quality supplies and services to protect the national interest. We are all dedicated to doing this. However, is the soldier the ultimate contracting TQM customer that must be supported, at all costs, to the point of expedience, and at the expense of quality contracts? Quality contracts can be defined as those that:

- Comply with all laws and regulations.
- Are awarded based on a sound business arrangement.
- Foster Congressionally mandated policies and social/economic and other goals.

In support of quality procurement, lead time may be longer than desired and all program manager preferences such as non-competitive systems contracting arrangements may not be able to be fulfilled.

In time of war, the soldier in the field is the primary TQM customer. However, in peacetime I submit that this is not the case. It is my view that the ultimate TQM customer for the Army contracting process is the U.S. taxpayer whose expectations are reflected in the laws, policies and philosophies enacted by Congress in the DOD Appropriation and Authorization Act and in the legislative record that supports them.

It ill serves the soldier in the field if we do expedient contracting at the sacrifice of slower more deliberate and considered contracting, if the former erodes the public's confidence in the Army or DOD contracting processes.

I further maintain that this is exactly what has happened during the last few years. The $600 hammer eroded the taxpayer's confidence in the early 1980s defense build-up. Although taxpayers don't know what a tank or howitzer should cost, they do know what a hammer should cost. To the extent that expedient rather than quality contracting contributed to the $600 hammer and other similar fiascos, and to the extent the current "Ill Wind" investigation is continuing that erosion,

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the soldier in the field is being denied needed support through reduced appropriations.

It has been said that perception is reality. If the American taxpayer perceives (largely incorrectly, as Ill Wind did not involve Army contracting) that the Army contracting system is filled with waste, mismanagement, fraud and corruption, then the soldier in the field will be ill served and will be denied needed increases in support.

Thus, it is the conclusion of this writer that the ultimate customer we must satisfy in our TQM of Army contracting is not the program manager, not the laboratory commander, not the procurement director, or his/her higher authority, not the auditor or investigator. It is not even the soldier in the field.

Ultimately, the TQM customer we must satisfy is the U.S. taxpayer expressing his voice through his elected representatives in Congress. And even more importantly, it is his perception (rather than the reality) of the Army contracting process that we must satisfy. Until we can do this, we will not have come to grips with the real TQM issues.

Local committees, process action teams, reports, etc can help. However, to the extent they focus predominantly on streamlining and shortening the local installation and command contracting process, in eliminating existing separate internal controls and in reducing or eliminating higher headquarters oversight, then the perception of expediency as opposed to quality will continue to persist. This is because the chances of new $600 hammers can increase.

We must, I submit, focus our TQM efforts on the contracting process, in the first five years at least, at the macro level and on departmental or DOD wide issues rather than at the local level.

We must ensure that we have well trained personnel with the highest integrity. We must ensure that regulations are based on sound business principles. We must allow people room for honest mistakes without turning every mistake into a criminal act.

We must turn contracting into a profession, grandfathering in those good people already in the field. We must not reorganize for reorganization's sake and to achieve perceived short term savings because to do so will cost us the best and the brightest professionals.

We must encourage participation in and contributions to contracting professional associations. We must root out fraud. We must emphasize planning and quality and oppose expediency. Only when we have done this at the macro level will we have satisfied the ultimate TQM customer — the U.S. taxpayer. Only after we have done this should we focus on the local contracting issues. In contracting at least, I submit that TQM is a top-down not a bottoms-up need.

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Smart Weapons Systems. . .

A LABCOM COOPERATIVE PROGRAM

By MAJ Andrew G. Ellis

Editor's Note: The following article was initially published in the December issue of Field Artillery.

Success on the modern battlefield relies on units and commanders that see beyond the requirements of the moment and use available assets to extend their operations in time and space. All operations should be focused on imposing our will on the enemy by throwing him off balance and disrupting the coherence of his operations. Attacking his second echelon forces will accomplish this.

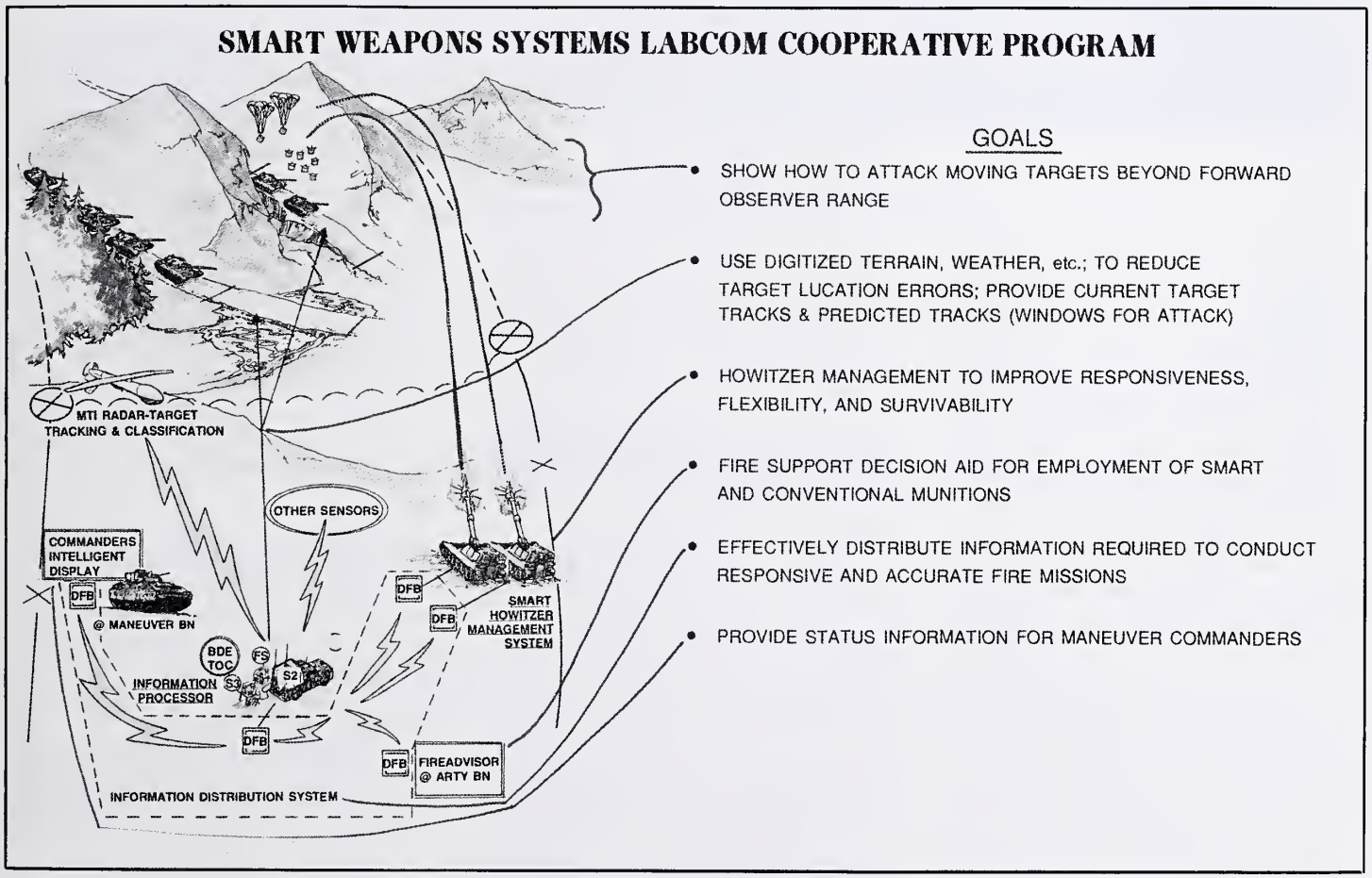
Deep attack to shape the future battle is an integral part of the AirLand Battle doctrine. But what is deep? For the corps commander, it may be hundreds of kilometers; for the brigade commander, it may be less than 10. Munitions from systems such as the Army Tactical Missile System (ATACMS), and fixed/rotary winged aircraft give the division and corps commander a deep strike capability. But the brigade commander, who has the same mission to strike "deep" within his area of operations, currently has a limited capability to carry it out.

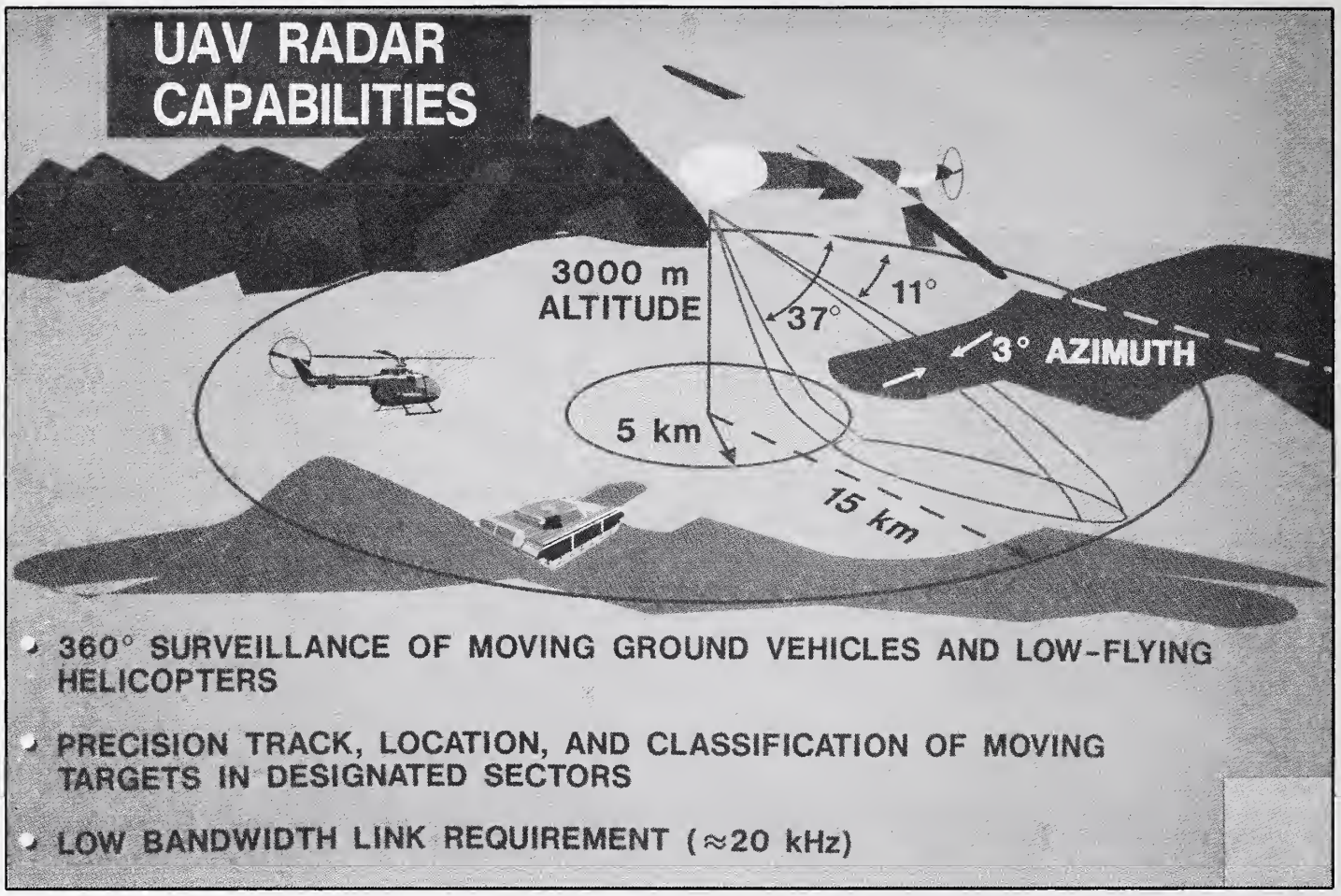
The Smart Weapons Systems (SWS) Army Laboratory Command (LABCOM) Cooperative Program gives the brigade commander the ability to shape his future battle by attacking forces with artillery prior to their arrival at the battle's forward edge. The program looks at the total delivery system, from acquiring targets to delivering munitions, and applies innovative technology and operational concepts that improve the effectiveness of conventional and small footprint smart munitions like SADARM.

This LABCOM cooperative program showcases several key technologies under development within Army laboratories and demonstrates how these technologies could be integrated into a system. Each component of the Smart Weapons Systems (SWS), however, is a "stand-alone" program that can be employed with existing or proposed weapons systems. The SWS demonstrates a concept rather than a particular system. The following scenario illustrates this concept.

A forward deployed mechanized brigade is decisively engaged by the regiments of an enemy division. As these regiments probe weak points in the defense and force a penetration, second echelon regiments in battalion column move along high speed avenues of approach to exploit this penetration. The enemy commander must reinforce the success of his first echelon before the defense has an opportunity to seal the penetration. For his attack to work, the enemy commander must commit his second echelon at the right place at the right time.

By doctrine, regiments in the second echelon will travel on roads in battalion column until they are within five to seven kilometers from the line of contact. These columns present a lucrative target that, if attacked, could disrupt





Mini-MTI Surveillance Radar for Unmanned Aerial Vehicles (UAV)

and delay the arrival of second echelon forces and destroy the coherence of enemy operations.

The location of the enemy column is detected by a moving target indicator (MTI) radar mounted on an unmanned aerial vehicle (UAV). This radar gives the location, speed, and direction of the column.

The information from the MTI radar is transmitted to a ground processor where the location, speed, and direction of travel of the column is compared with the location of roads from digitized map data. As these columns normally travel on roads, target location errors of the radar can be reduced by aiming at future locations along the road called attack windows. Because the system aims at sections of road and the target is a column of vehicles rather than a single vehicle, conventional and smaller footprint Smart Weapons can be used to attack these moving targets.

Radar tracking information, along with digitized map and weather information, is used to predict the arrival of the column into areas along the road previously selected as attack windows. These windows are selected to optimize the effects of the attack. Restrictive sections of road, such as cuts or passes through heavily forested areas, may be ideal as attack windows.

Just prior to the column's entry into the selected attack window, the radar provides a final update on the column's movement. This update gives the system a refined arrival time. Because delivery accuracy decays over time, information must be distributed in a timely and efficient manner. Transmission of this critical information over low band-width radios is optimized by using computers to reduce the amount of data transmitted and the length of radio transmissions.

With the attack window specified, an engagement time identified, and the information distributed, recommendations on how best to attack the target are needed. A program for the tactical control of fires that uses fire unit information, target values, and commander's guidance recommends a delivery system and the number and type of munitions to use against the target.

Autonomous howitzers selected to attack the target compute aim points, and times to fire with on-board computers. The enemy column now in the attack window is fired upon.

SWS Components

The SWS uses a systems approach to solve the problem of attacking moving targets. It maximizes the effectiveness of the system without any single component being excessively costly or complex. In simple terms, each component is called upon to reduce delivery

errors rather than rely solely on "very smart" or "brilliant" munitions.

MTI Surveillance Radar for UAVs

Engaging second echelon forces requires an "over-the-hill" target acquisition capability. The MTI (a Joint Defense Advanced Research Projects Agency and Harry Diamond Laboratories effort) provides high performance, real-time target detection, location and tracking of moving ground vehicles and low-flying helicopters within a 15-kilometer surveillance region. The mini-MTI radar has three distinct operating modes: wide-area surveillance, ground target track/classification, and helicopter track/classification, with each mode optimized to its particular requirements. The radar signal processor, designed and constructed for this technology development, converts raw radar data into individual target reports which can be used by other radar ground stations such as the Joint Surveillance/Target Attack Radar System Ground Station Module (JSTARS GSM).

The radar weighs less than 110 pounds and consumes approximately one kilowatt of prime power. It is currently packaged to fit in an Amber endurance Unmanned Aerial Vehicle but is compatible with other mid-sized UAVs.

The mini-MTI radar is expected to have an important role providing real time target acquisition, location and classification capability for commanders in the intelligence and electronic warfare as well as fire support mission areas. Future applications may include air defense and maneuver battlefield mission areas.

The Information Processor

Once moving targets are located, delivering effective fire requires selecting the best place to attack and predicting when the target will be there. The information processor (IP), also a Harry Diamond Laboratories product, integrates the target data with digitized map data, weather information, and other known tactical information. From this process, predicted target locations and attack windows are used for fire support planning and execution.

The IP test bed collects, processes, and disseminates time- critical combat information on the battlefield. The IP demonstrates the integration of information among the intelligence and electronic warfare, fire support, and maneuver control battlefield functional areas. It communicates with automated and manually operated sensors and other tactical command and control systems via standard Army radios.

The IP can automatically track and correlate targets using information obtained from multiple sensors located on the battlefield. This function, combined with the ability to use terrain knowledge with doctrine, provides the operator with the capability to track multiple tactical situations in near real-time. A message storage and retrieval system processes all incoming and outgoing messages and greatly assists the operator in detecting key events on the battlefield.

The IP test bed is housed in an S-250 shelter which is mounted on a Commercial Utility Cargo Vehicle. The information processor is a flexible, powerful, and mobile real-time tool for multi-sensor and multi-battlefield functional area integration and provides the commander with a unified picture of the tactical situation.

Tactical Information Distribution System

Agility on the battlefield requires getting the right information to the right people on time. This becomes a difficult task considering the volume of battlefield information that must be passed over low band-width radios. The Ballistic Research Laboratory's Tactical Information Distribution System (TIDS) is an experimental software project that provides terse and efficient information exchange over the low capacity radios normally found below division. Since the value of moving target information decays over time, it must be passed as quickly and concisely as possible.

The basic concept behind the TIDS is to use the power of computers to reduce the amount of data transmitted, format the information in its most concise form, and send it to those who need it.

The basic concept behind the TIDS is to use the power of computers to reduce the amount of data transmitted, format the information in its most concise form, and send it to those who need it. The TIDS is an experimental software project that uses innovative command and control concepts and implementation techniques to distribute battlefield information quickly and efficiently. The basic TIDS architecture divides its software into two categories: information distribution, common to all nodes, and application programs (such as tactical fire control, movement control, and other battlefield management functions) that are based on the particular requirements of the node.

The primary focus of the BRL TIDS is information distribution. This distribution system is composed of three main software modules, each demonstrating a novel concept. The security control module supports both automatic information distribution to other users and automatic notification to application programs residing on the system. A new communications protocol, the Fact Exchange Protocol, exploits the broadcast nature of tactical radios to minimize excessive transmission times.

Finally, data abstractions of military concepts have been developed that represent military information in a primitive form that is suitable for computer manipulation and dissemination. In addition, each piece of information is assigned a tag that uniquely identifies it as it propagates through the system. Together, these features eliminate many of the mundane tasks associated with information manipulation, management, and distribution and allows the soldier to concentrate on fighting.

FireAdvisor

The high intensity battlefield is often characterized as a target rich environment. But with limited fire support assets, commanders will be faced with tough targeting decisions: which targets to attack and when, what munitions to

The SHAMS helps the howitzer commander perform tasks to manage his assets and meet his tactical requirements.

Functional Areas			
Fire Mission (FM) Tasks	**Ammo/Logistics Tasks**	**Vulnerability Tasks**	**Crew/Equipment Tasks**
FM Bid Response Section Tasks FM Data Base Ballistic Solutions Warnings & Prompts	Ammo Usage Prediction Ammo Re-Allocation Ammo Resupply Automatic Reporting	Data Accumulation Warnings & Prompts Data Entry Automatic Reporting	Status Accumulation Status Entry Warnings & Prompts Automatic Reporting

use, and how best to allocate assets against these targets.

FireAdvisor, another Ballistic Research Laboratory project, is software designed to help commanders answer these questions. It uses target information, fire unit status, munitions effectiveness, and commander's guidance and recommends allocating and planning for the use of available fire support assets.

FireAdvisor focuses on dynamic fire planning and provides traceable recommendations for tactical fire control at brigade level. FireAdvisor integrates techniques of operations research and artificial intelligence with realistic tactical rules to develop sequences of fire missions. Fire unit information, target values, and factors concerning weapon-target pairing are combined with commander's guidance, munition choice routines, and estimates of future missions to produce plans. These plans provide an overall payoff as well as the numbers of projectile-fuze combinations to be used against various targets.

Explanations of various solutions and rules are available to the operator. He may also modify rules and guidance, and examine the feasibility of other attack methods. FireAdvisor opts for satisfactory solutions in terms of overall payoff against an expected target array. FireAdvisor will reside as an application program on the TIDS.

Smart Howitzer Automated Management System

With the advent of autonomous howitzers, functions such as survivability moves, ammunition resupply, and fire mission processing will become the responsibility of the howitzer commander. A Human Engineering Laboratory project, the Smart Howitzer Automated Management

The Commander's Intelligent Display (CID).



System or SHAMS is a software development program designed to assist the howitzer commander in managing these new responsibilities.

SHAMS explores the concept of an automated, interactive howitzer command, control, communications and intelligence distribution system. This effort evaluates a computer based aid that will allow a firing element, consisting of two howitzers and two ammunition resupply vehicles, to operate autonomously.

The SHAMS consists of software, in an on-board computer, that helps the howitzer commander manage his assets. This system provides: an interactive planning aid, automatic reminders by issuing warnings, prompts for required or desired actions, and an automated reporting system to higher headquarters.

The four main system areas that will assist the chief-of-section to control and meet tactical requirements are shown in the accompanying chart.

Commanders Intelligent Display

The final component of the program is the Commander's Intelligent Display (CID), a prototype flat panel display developed by the Army Electronics Technology and Devices Laboratory. It will interface with the Information Distribution System and display information for battalion commanders. The CID demonstrates command and control application programs for commanders using flat panel display technology.

The CID contains a computer that uses the UNIX operating system with x-windows. With this system, the CID is capable of several multi-tasks. The CID will be networked with the Information Distribution System through standard tactical radios in order to access and display near real time data of interest for commanders. The CID will have an internal data base for the area of interest and will be capable of displaying map and graphic data within five seconds of the user's request. The CID provides a low weight, low power, portable interactive display capable of accessing electronically stored data to assist the commander in preparing for and directing the battle.

Conclusion

The SWS Program lashes each of these components together and provides the brigade commander with the ability to attack, disrupt, and delay second echelon forces in his area. The program uses the decide, detect, and deliver targeting approach by prioritizing second echelon targets, locating them on the battlefield, and attacking them in a timely manner.

The decide phase examines enemy doctrine and exploits its weaknesses. Once lead elements have forced a penetration in the defense, the enemy commander commits his second echelon before the defense has time to react. Because speed and mass are critical when committing combat power, second echelon regiments travel in battalion column between 10-12 kilometers to 5-7 kilometers forward of the line of contact.

When the Soviet commander breaks his subordinate units into pre-battle formations, he is essentially locked-in to his portion of the higher commander's plan. In simple terms he has lost his maneuver flexibility. Attack of these columns, between 5 and 12 kilometers from the line of contact, could disrupt and delay the arrival of the second echelon and destroy the continuity of enemy operations at a point where the regimental commander has lost his flexibility. Based on this doctrine, planners select areas on the roads called attack windows that optimize the engagement of a vehicle column.

The detect phase confirms projected enemy movements by locating and tracking second echelon forces with the mini-MTI radar. This tracking information is transmitted to the information processor where it is matched with known road locations. A prediction of when the column will enter the attack window is made. The arrival time of the column in the attack window and the classification of wheeled or tracked vehicles are quickly disseminated by the Tactical Information Distribution System to commanders and fire support planners.

In the deliver phase, FireAdvisor recommends how best to attack the target. A delivery system and the number and type of munitions is selected. For those howitzers selected, SHAMS computes the ballistic solution and time to fire...aims...and fires. Munitions are delivered on time and on target.

AirLand Battle doctrine states that the object of all operations is to impose our will upon the enemy — to achieve our purposes. To do this, we must throw the enemy off balance with a powerful blow from an unexpected direction and disrupt the coherence of his operations. The attack must be rapid, unpredictable, violent, and executed in such a way to prevent the enemy commander from taking effective counter-actions.

Attacking committed second echelon regiments will achieve this. The Smart Weapons Systems LABCOM Cooperative Program gives brigade commanders this ability.

NOTE: Technology/Concept Demonstration of the SWS targeting process will be conducted at Fort Sill, OK in early summer 1990. This effort involves the coordinated work of the Field Artillery School, the Intelligence School, and Harry Diamond Laboratories. This demonstration will show, in the field, the capabilities of the mini-MTI radar and the Information Processor in providing timely and accurate targeting data on moving vehicles. In addition, plans are being considered for SWS follow-on activities that include a live-fire exercise.

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DESIGN TO COST

By John P. Rosso Jr.

Introduction

The concept of Design to Cost (DTC) has been with the government for well over two decades and with private industry even longer. It started out as a "buzz word." However, in current times — where resources (money and people) are becoming extremely limited and in an era when the taxpayers are becoming more vocal in demanding more for their tax dollar — the government has revised and revitalized the original concept and has attempted to institutionalize this new concept of Design to Cost.

Originally, the concept of Design to Cost Focused on "Design to Unit Production Costs (DTUPC)." But as the concept matured and more experience was acquired, it was found that this did not work; you cannot design only to a Unit Production Cost. You must strive to achieve a balance between the cost to develop and produce, the cost to operate and support, as well as performance and schedule as indicated in Figure 1.

Requirements

Design to Cost is mandated by Department of Defense Directive (DODD) 4245.3 for all major programs as defined in DOD Instruction 5000.2. The services must implement DTC on all major programs or obtain a waiver. Implementation on less than major programs is left up to the discretion of each specific service.

Army Materiel Command Headquarters has taken the lead in implementing DTC throughout the Army. DTC is mandatory for all less than major Army programs: where a significant developmental design is required, where the production contract is predicted to exceed $40M and only where it is cost effective. This includes: conceptual programs, demonstration/validation programs, full scale engineering development (FSED) programs, product improvement programs (PIPs), major modification programs and software programs. Of course the DTC effort must be tailored to accommodate the specific phase of the program.

Opportunities for DTC

Figure 2 indicates when decisions concerning Design to Cost have to be made (as early in the program life as feasible). By the beginning of FSED, 85 percent of the opportunities for making design changes have already been missed, and by the end of FSED 95 percent of the opportunities to make design changes are history.

Definition

By definition, DTC is a management concept wherein rigorous cost goals are established during the early development phases. The control of system costs (acquisition, operation and support) is achieved by establishing goals which are derived from a list of identified cost drivers. Practical trade-offs between new technology, operational capability, system requirements, cost and schedule are conducted. Cost is then perceived as a key design parameter, addressed on a continuing basis and as an inherent part of the development engineering process.

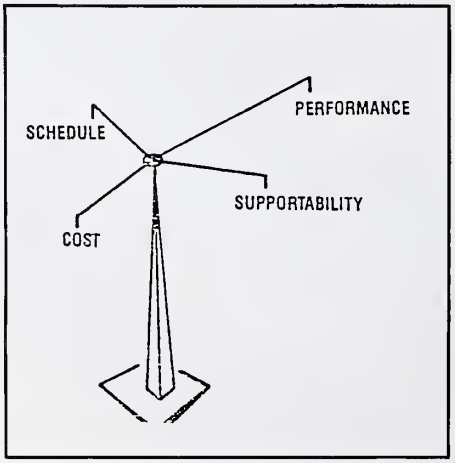


Figure 1.

In the context of Design to Cost, "cost" is interpreted as "life cycle cost"; therefore, all alternatives that are selected must be evaluated for their life cycle cost impact.

Objective

The objective of DTC is to achieve the best possible balance between cost, performance, supportability and schedule. As implied above, the cost in the term Design to Cost means all costs associated with the programs as defined in DOD Instruction 5000.33. Strict adherence to this philosophy will result in the government's purchase of affordable weapon systems being fielded on schedule and meeting or exceeding performance goals.

Responsibility

Who is ultimately responsible for the implementation of the Design to Cost Program? The program/project product manager (PM) has the overall responsibility for implementing DTC, however, they will usually appoint someone who is trained in this area to actually see that it is accomplished.

The PM must be the driving force behind the DTC program if it is to be a success. However, it requires a joint effort on the part of all functional experts working together and using total quality management with emphasis on concurrent engineering.

Implementation

To implement a Design to Cost

Program, the following steps must be accomplished:

- A DTC implementation manager must be appointed by the government and by the contractor.
- The DTC implementation manager in consonance with the PM must be highly knowledgeable of the DOD and service unique policy regarding DTC and be totally familiar with all aspects of the development project requirements.
- The program office DTC implementation manager must also alert the PM of all DTC funding requirements (e.g., award fees, trade study costs, engineering time, etc.). They must know those with whom they must interface (e.g., program managers, systems/design engineers, logisticians, cost analysts, procurement (contracting) specialists, legal officers, configuration management specialists, data management specialists, resource management specialists, producibility engineers, quality specialists, productivity engineers, reliability/maintainability engineers, training specialists etc.). All of these functional experts must be brought on board as early in the program life cycle as feasible and they must work together closely sharing information and making joint decisions.

The program office DTC manager must become familiar with and provide input to all appropriate documents e.g., Operational and Organizational Plan, Program Directive, Program Management Plan, Acquisition Plan, Required Operational Capability, Request for Proposal, etc. associated with the project in which he or she is implementing DTC. The DTC manager must also develop or have the contractor develop a Design to Cost implementation plan that identifies cost drivers (high risk areas), Design to Unit Production Cost goals, and Designs to Operations and Support Cost Goals. The DTC manager, in conjuction with the contractor, must also identify trade studies to be conducted, alternatives, models to be used, methods of tracking design changes and their associated costs, and methods of informing the PM when problems in meeting the goals are encountered.

In addition, the program office DTC manager must maintain the documentation (an audit trail of all DTC actions), track the progress that the contractor is making in achieving the goals, and track the payments or non-payments of DTC incentives, award fees, and warrantees.

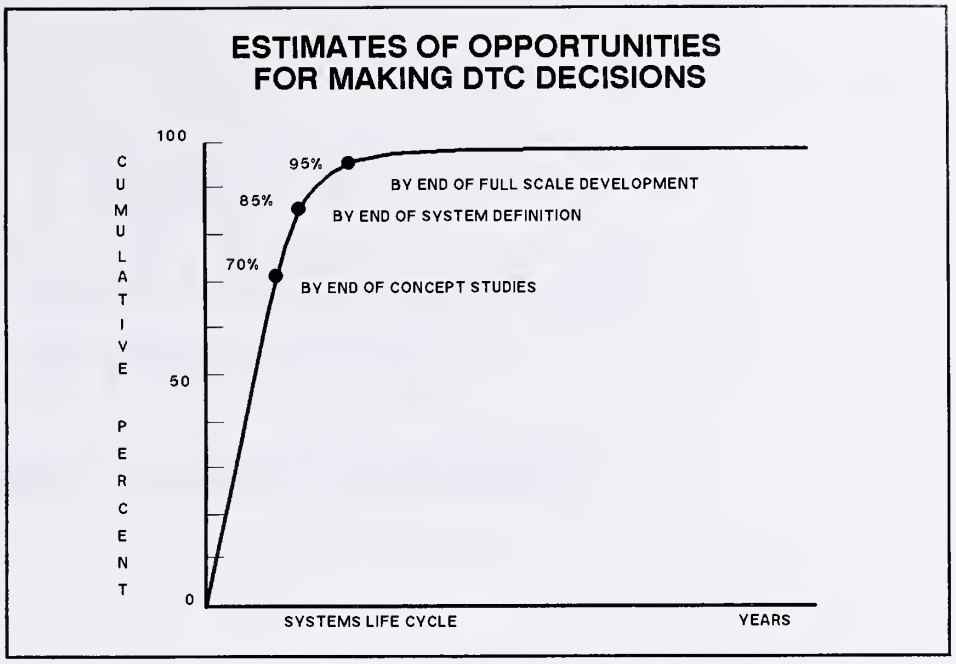


Figure 2.

Other Considerations

The DTC implementation manager must not only ensure that equal emphasis is given to schedule, performance and costs (including operations, support and disposal costs) but that the design further ensures the timely, cost-effective consideration of modularity, standardization, simplicity, accessibility, adaptability, interchangeability, maintainability, supportability, reliability, and numerous other factors. Given the investigation of these considerations and the results of the trade studies, the DTC implementation manager makes recommendations to the PM, who in turn makes the design decisions.

Conclusions

As you can see, the DTC implementation managers play a vital role in the acquisition process and they have their work cut out for them. But DTC is a good way to control costs and a good way to do business. This is just a brief overview of the activities involved in the DTC process. For a more comprehensive insight refer to the following references: DODD 4245.3 "Design to Cost," 6 Apr 83; DOD Mil Std 333 "Design to Cost," 24 Jul 89; DOD Mil Handbook 766 "Design to Cost," 25 Aug 89; DOD DTC Data Item Description 80856, "Design to Cost Plan," 19 Jun 89; DOD DTC Data Item Description 80857, "Design to Cost Report," 19 Jun 89; AR 70-64 "Design to Cost," w/chg, 1 Dec 88; and, AMC Guide — "AMC DTC Guide" AMCP 70-19, 22 Jul 87.

JOHN P. ROSSO JR. is an operations research analyst/industrial engineer assigned as the Army Materiel Command Design to Cost program manager. He has a B.S. degree in mathematics and psychology from Jacksonville University in Florida and has completed most of the requirements for a master's degree in industrial engineering.

The DOD University Research Initiative...

ARMY-CENTER COLLABORATIVE EFFORTS

By Dr. Robert W. Shaw

Background

The president's budget for 1986 contained a new initiative to advance basic science and engineering capabilities specifically to provide a technology base for long term defense of the United States. This initiative provided funds for University Research Centers. Universities perform more basic research than any other part of American society and they also educate our future scientists and engineers; hence they have a crucial, double role in the long term advancement of technology.

The Army established research centers at the beginning of fiscal year 1987. This was described in a previous article in *Army RD&A Bulletin* (Pages 6-8, Jan-Feb 1987). The centers are listed in Table 1. Briefly, the centers are required to carry out four principal missions: basic research relevant to the Army mission; education of graduate students in skills important to the Army; development of state-of-the-art research equipment; and communication, collaboration, and exchange with scientists at Army laboratories and RD&E centers.

The centers are large and complex organizations of many people and no brief article could describe their research accomplishments, equipment developed, or graduate training programs. Similarly, there have been numerous interactions between center and Army scientists, too many to enumerate here. This article highlights some of the collaborations and exchanges among the University Research Initiative (URI) Centers and Army scientists.

- *The University of Delaware Center for Manufacturing Science* focuses on development and application of composite materials to replace heavier metallic materials. "Composite" covers a wide range of structured materials. For example, a composite could be a series of layers of tough, woven textile held together by adhesive. The main goal is to develop new construction materials by tailoring combinations for strength, flexibility (or rigidity), long life, etc. Strong, light materials have many uses, including armored vehicles, shelters and bridges.

Currently, there are three major collaborative efforts between The Delaware center and Army scientists and contractors: with the Army Materials Technology Lab and FMC Corp. on materials for the Bradley Fighting Vehicle; with the Army Tank-Automotive Command and General Dynamics Corp. on manufacturing of thick section composites; and with TACOM and Sandaire Corp. on lightweight materials for trailers.

Other collaborations involve work with the Army Missile Command on improved manufacturing reliability of missile components and with the Chemical RD&E Center on improved gas mask materials. Center scientists are also working with the Aviation Research and Technology Activity, Belvoir RD&E Center, Ballistics Research Lab, Armament RD&E Center and Benet Weapons Lab on composites for rotorcraft, bridging, armaments and missiles. Two civilian Army scientists from BRL and three uniformed officers are working full time at the center.

- *The Wisconsin Center for Advanced Propulsion Systems* is conducting research to improve diesel engines. The goals are to reduce system weight, volume and fuel consumption and to improve maintainability. Other goals are to reduce sensitivity to degraded fuel and to adverse environments. Although the emphasis is on diesel engines, this research is also expected to advance gas turbine technology.

The Tank-Automotive Command has provided the Wisconsin center with four engines for research. TACOM is also collaborating directly on studies of ceramics for lightweight, high temperature engines by providing expertise on measurements of thermal stresses leading to ceramic failure. The Materials Technology Lab provides monolithic ceramic material samples and a uniformed Army officer is studying and doing research at the center.

- *The High Frequency Microelectronics Center at Michigan* does research aimed at developing very fast electronic devices. The Army has special needs for devices able to acquire information (sensors) over a very broad frequency range and to process this information at very high rates — the problem of acquiring and choosing among numerous targets on a changing battle field in real time.

The Michigan center collaborates with the Electronics Technology and Devices Lab and the Harry Diamond Labs on device design and fabrication. This work has led to advances in optical control of radar elements and high speed data processing. Army scientists have collaborated with scientists at the

TABLE 1

THE ARMY UNIVERSITY RESEARCH INITIATIVE CENTERS

CENTER	UNIVERSITY	GOALS
Advanced Construction Technology*	MIT, Illinois	vertical construction materials, robotic construction, non-destructive analysis
Manufacturing Science	Delaware	cheap, light, durable materials
Dynamic Performance Materials	UC-San Diego	materials to withstand high energy, shock
Advanced Propulsion Systems	Wisconsin	diesel, turbine engines for better logistics
High Frequency Microelectronics	Michigan	battlefield analysis and decision making
Electro-Optics, Signal Processing and Image Understanding	Rochester	target acquisition, laser protection
Intelligent Control Systems**	MIT/Brown/ Harvard	machine intelligence for weapons guidance and control
Fast Transient Processes	Southern California	high performance, safer propellants & explosives
Biotechnology	Cornell	improved materials chem/bio defense
Geosciences	Colorado State	battlefield weather analysis and forecast

* two centers
** consortium

Information on all aspects of the Centers is available from the office of Dr. George Neece, Director, Research and Technology Integration, Army Research Office, Research Triangle Park, NC 27709-2211; 919-549-0641 or AV 935-3331.

center to develop new ultrafast photodiodes and to demonstrate the utility of piezoreflectance spectroscopy. These scientists have coauthored research publications describing this work.

Scientists at the center have also conducted joint research programs with Army scientists on advanced millimeter-wave devices, superconducting ring resonators, and on novel ohmic contacts for high performance gallium arsenide electronic devices. The center has also provided Army labs with advanced semiconductor materials.

- *The Center for Intelligent Control Systems* is an inter-university (Brown/Harvard/MIT) interdisciplinary center for research in the foundations of intelligent machines and intelligent control systems. Research activities of the consortium include signal processing, image analysis and machine vision, modern control and mathematical foundations of machine intelligence.

The Brown/Harvard/MIT center is collaborating with several Army labs and RD&E centers. For instance, with the Center for Night Vision and Electro-Optics and the Harry Diamond Labs, this URI center is advancing the state-of-the-art in the evaluation of autonomous sensors and enhancement of infrared images as well as fundamental research on probabilistic image modeling. This interaction between the center and the Army is likely to have significant impact on approaches to machine vision, specifically on computer processing of infrared images in real-time and in detection and recognition of objects in laser-radar images.

The work on modern control theory is likely to contribute to tank gun fire control work at the Armament RD&E Center. This research is aimed at the design of high performance, robust and stable controllers. The collaboration with the Human Engineering Lab (HEL) is aimed at autonomous systems control with primary emphasis on control law development and analysis. This work is directly related to HEL's activities in Field Material Handling Robot Technology (FMR-T).

- *The Center for The Study of Fast Transient Processes at University of Southern California* is studying very fast chemical reactions important to ignition and combustion of propellants and explosives. The Army is the lead agency for development of energetic materials and the principal goals are improved performance and safety. Although the chemical products remaining at the end of energetic materials combustion are known, almost nothing is known about the intermediate steps in ignition and combustion. Information about those steps will enable the production of more controllable energetic materials.

Working at the University of Southern California center and collaborating with center research workers, scientists from the Ballistics Research Lab and from the Armament RD&E Center have studied fundamental processes of the break-up of a high energy binder and an explosive. This work has been reported in coauthored papers at recent meetings of the Detonation Symposium and the Joint Army, Navy and Air Force Combustion Meeting. In another collaboration, a uniformed officer serving on the faculty at West Point has carried out molecular decomposition experiments at the center in preparation for further research in the labs at West Point.

- *The Center for Biotechnology at Cornell* collaborates with Army scientists in two principal areas — materials and medicine. Biotechnology refers to the controlled use of living cells or cell components. This control allows us to turn the complex chemistry evolved in nature over millions of years to our advantage. Much of this work seeks to produce complex and desirable materials that would not be practical using other methods.

A research worker from Natick RD&E Center is spending 18 months at the Cornell center studying the structure of silk. The goal is to lighten the soldier's load by devising super-strong, superlight fabrics. Spider silk is a good candidate material for ballistic protection and the Natick-Cornell collaboration seeks to understand how the silk structure confers its special properties. The center also participates in cooperative research with the Walter Reed Army Institute of Research on infectious diseases and is training scientists from the Medical R&D Command on new genetic engineering methods.

- *The University of Rochester Center for Electro-Optics, Signal Processing and Image Understanding* does research to separate targets from other objects and to protect against laser threats. Each of these goals involves basic research in many areas of optics including optical and radar sensors, fiber optics and target recognition.

Working with the center for Night Vision and Electro-Optics, the Rochester center scientists have developed an inexpensive and sensitive device for identifying and locating laser signals when many other light sources are present. These devices are assembled from off-the-shelf components and are already being field tested for protection against optical threats.

Summary

This brief article has outlined several examples of one of the Army University Research Initiative Centers' principal goals: direct collaboration between Army and center scientists. Even this limited list is not complete — in scientific research people continually come together to collaborate, work on a problem, and then separate again.

This article has not included cases of direct technology transfer from the centers to the Army and there are many cases where the Army has benefitted considerably even though no collaboration has occurred. In addition to the partial list of specific collaborations described above, there have been numerous visits between center and Army scientists, consulting for Army labs by the centers, special scientific meetings held at the centers, and courses taught at Army labs by center experts. Army, Navy and Air Force scientists serve on the committees that periodically review the centers' performance and provide center scientists with their own perspective on the goals and successes of center research. Clearly, in the mission area of collaborative research, the centers have developed a successful, vigorous and wide ranging program.

DR. ROBERT W. SHAW is associate director of chemistry and biological sciences at the Army Research Office. He has a B.A. in chemistry from Williams College and a Ph.D. in physical chemistry from the University of Washington.

THE ARMY ACQUISITION CORPS

What Does the Future Hold?

By COL John R. Bramblett
and LTC Daniel D. Ziomek

What is the Army Acquisition Corps?

The Army Acquisition Corps (AAC) was approved by the Army chief of staff and secretary of the Army in response to directions contained in the Defense Management Review (DMR) submitted to the president by Secretary of Defense Cheney in July 1989. The DMR required each of the Services to establish a dedicated corps of military acquisition specialists whose career development would provide the proper blend of operational and acquisition experience with the required acquisition training and education to serve as successful program managers. It further tasked the Services to insure that promotion opportunities to the highest flag and general officer ranks would be provided for acquisition corps members. A summary of the DMR requirements is contained in Figure 1.

DEFENSE MANAGEMENT REVIEW
KEY TENENTS FOR MILITARY OFFICERS

- "ESTABLISH DEDICATED CORPS OF OFFICERS"
- "EXPERTS IN DISTINCT SUB-SPECIALTIES"
 - •• SYSTEMS DEVELOPMENT
 - •• PROCUREMENT
 - •• LOGISTICS
- "SELECTION OF HIGHLY PROMISING OFFICERS EARLY IN CAREER"
- SIGNIFICANT OPERATIONAL EXPERIENCE
- DEVELOP AND RETAIN ACQUISITION SKILLS
 KEEN REGARD FOR OPERATIONAL REALITIES
- ATTRACTIVE / EQUITABLE CAREER PATHS
- DESIGNATION OF CORPS ELIGIBLE POSITIONS
- ASSURANCE OF PROMOTION POTENTIAL TO HIGHEST FLAG GRADES
- PROVISION FOR ADVANCED MGMT AND TECH TRAINING

Figure 1.

ANNUAL ACCESSIONS

FA / BR	51	52	53	97	15/35	TOT
11	18			1		19
12	10			1		11
13	21	3				24
14	23					23
15	11			2	4	17
18	3		3			6
21	3			1		4
25	26		11	1		38
31	1			1		2
35	16					16
42			3			3
74	5					5
88	8		3			11
91	21		3	4		26
92	4		3	1		8
TOT	170	3	24	12	4	213

Figure 2.

The DMR tasking coincided with the ongoing efforts to restructure the Materiel Acquisition Management (MAM) program by the MAM Proponent Office, PERSCOM, and the Office of the Assistant Secretary of the Army (Research, Development, and Acquisition). The restructuring was necessary to comply with recent legislation, recommendations from the Leader-Development Study, and the problems identified in a PERSCOM review of the MAM program completed in 1988. The PERSCOM review showed, among other problems, that only 24 percent of positions requiring MAM officers were filled by MAM officers. To correct the problems and bring the program into compliance with public law and Department of Defense Directives, a restructured MAM program was created and redesignated as the military portion of the AAC.

How the New Program Will Work

The AAC is a combined military and civilian program which will develop a dedicated pool of highly qualified acquisition specialists to fill designated critical acquisition management positions while ensuring that the development of weapon systems reflects a balance between keen regard for current operational realities and technical knowledge. The new program will develop military acquisition specialists to fill 359 colonel and lieutenant colonel critical acquisition management positions.

All officers who hold Functional Areas (FA) 51 (RDA), 52 (Nuclear Weapons), 53 (Systems Automation), and 97 (Contracting and Industrial Management) will be reviewed by a DA centralized board during their eighth year of service for entry into the AAC. Officers may request entry if they hold an eligible FA but final determination will be made by the board to include accession of officers who have not applied for the AAC. Annually, 213 officers will be accessed into the AAC. The breakout of branch and FA pairings is shown in Figure 2.

Once selected for the AAC, the officer will be awarded Skill code 4M (AAC Candidate) and his or her personnel file moved from the Branch Assignment Section to the Military Acquisition Management Branch in the Functional Area Management and Development Division (FAMDD) at PERSCOM. Functional Area assignment officers will then have primary responsibility (FA primacy) for assignment of AAC members.

Any officer who is selected for the AAC and who does not have an advanced degree will be scheduled for the Army's Advanced Civil Schooling program and offered the opportunity to obtain a master's degree in management, business, science or engineering. Following civil schooling, the AAC officer will attend the nine week MAM Course at the Army Logistics Management College en route to an acquisition assignment.

At least 50 percent of the AAC officers will attend the resident Command and General Staff College and all AAC officers

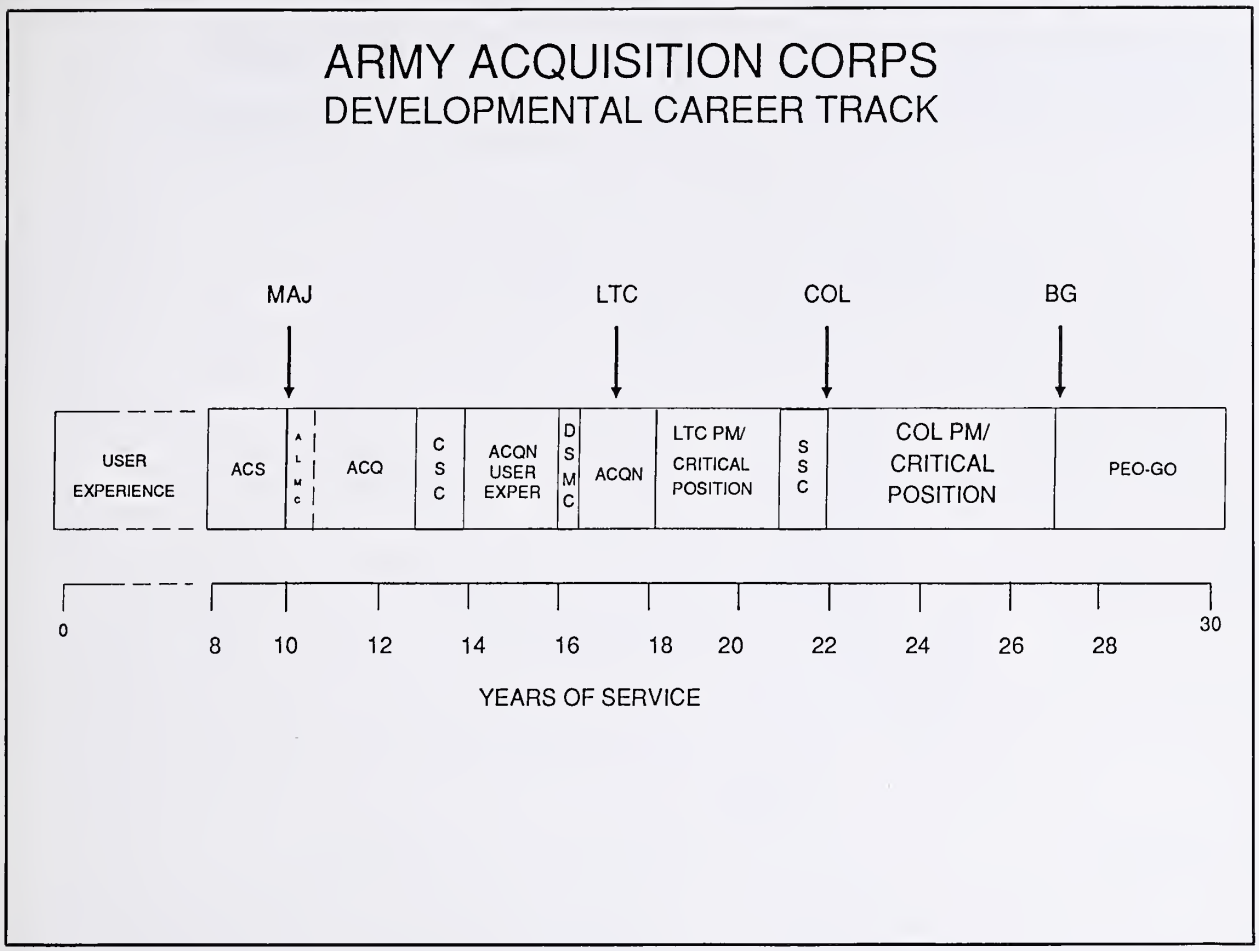


Figure 3.

will be programed for an acquisition related operational assignment as a major. This will be the last "branch assignment" an AAC officer will receive and provides another opportunity to experience problems with current weapon systems from the soldiers' perspective.

From this point, the AAC officer will serve exclusively in acquisition assignments following attendance at the Program Management Course (PMC) at the Defense Systems Management College. As a lieutenant colonel, members compete for one of the 244 critical acquisition positions, including 86 product manager positions. As a colonel, the AAC officers again compete for one of the 115 critical positions which include 75 project manager assignments. A life cycle model for the typical AAC officer is shown in Figure 3. It should be noted that AAC officers will not compete for battalion or brigade level command.

Certification

A key element in the AAC program is the certification process to comply with legislation and DOD Directives. Level I Certification will be accomplished by a PERSCOM board which will review the files of all AAC officers upon selection for lieutenant colonel. Officers who have achieved at least three years of acquisition experience (one year in a procurement command) and have attended the PMC will be certified and awarded Skill code 4Z in lieu of the 4M. Level II Certification will be accomplished by a similar board upon the officers' selection for colonel and will require eight years acquisition experience (two years in a procurement command) and attendance at PMC. Only certified officers are eligible to fill the critical acquisition positions as a lieutenant colonel and colonel. A recent change to the law now identifies a "Procurement Command" to be the Army Materiel Command, Information Systems Command, Strategic Defense Command or as a member of the staff of the Army Acquisition Executive, a PEO or a PM. Qualifying acquisition experience will be any assignment in a position coded FA 51 or 97 and selected positions coded FA 52 or 53 on authorization documents.

Promotion Opportunities

Memorandums of Instruction to lieutenant colonel and colonel promotion boards will insure that selection rates for AAC officers equal the rates for the entire Army Competitive Category. Use of floors for 4M and 4Z officers as well as prescreening of files prior to the board will accomplish this goal. Only qualified AAC officers will be promoted against floors established to meet the Army's requirements. By law, all general officers assigned to procurement commands, as defined above, must meet the Level II Certification standards or be granted a waiver by the Secretary of the Army. Thus, the opportunity for promotion to the highest general officer ranks is included in the new program for AAC officers.

ARMY ACQUISITION CORPS
PARTICIPATING COLLEGES & UNIVERSITIES

- NAVAL POSTGRADUATE COLLEGE
- ARMED FORCES INSTITUTE OF TECHNOLOGY
- GEORGE WASHINGTON UNIVERSITY
- BABSON COLLEGE
- HARVARD UNIVERSITY
- TEXAS TECH
- UNIVERSITY OF COLORADO
- UNIVERSITY OF ALABAMA
- UNIVERSITY OF SOUTHERN CALIFORNIA
- DREXEL UNIVERSITY
- UNIVERSITY OF MICHIGAN
- BOSTON UNIVERSITY
- WASHINGTON UNIVERSITY
- GEORGIA INSTITUTE OF TECHNOLOGY

- TOTAL ANNUAL COST (FY90$) = $2,449,300

Figure 4.

Impact on Army Officers

To assist in making career decisions, we have used the results of modelling conducted by a PERSCOM/AMC/ASA(RDA) Task Force which sized the AAC to Branch/FA pairings at each grade from captain through colonel. In steady state, the AAC will have about 3,000 participants. Approximately 2,400 of these officers will hold FA 51, 45 will be in FA 52, 327 will hold FA 53, and 165 will be from FA 97. The first decision point occurs when officers receive their FA at the fifth year of service.

Since officers may request a specific FA, those desiring a career in the Acquisition Corps must select FA 51, 52, 53, or 97. It is important to point out that holding one of these FAs will not insure entry into the AAC but is a necessary prerequisite to apply for and enter the AAC at the eighth year of service.

PERSCOM will announce the AAC Selection Board by world-wide message and those officers who desire a career in systems acquisition management should submit a written request to PERSCOM in response to their message. The application letter will be included in the officer's file reviewed by the selection board. As always, be sure your Officer Record Brief is current and that a recent photograph is on file at PERSCOM prior to the selection board.

Once selected to participate in the AAC, the career path shown in Figure 3 is the one these officers will follow. Most of the selectees will be programed to attend advanced civil schooling to obtain an MBA degree. Those officers with an undergraduate degree in science or engineering will be considered for an advanced degree in science or engineering. Currently, the colleges and universities shown in Figure 4 are being used as the principal educational facilities for AAC members.

The Philosophical Change

The Army's leadership has taken a bold step forward to demonstrate their commitment to establishing and maintaining a world-class acquisition corps. We will no longer settle for "acquisition qualified branch officers" but will now have a cadre of "branch qualified acquisition officers." Young officers will be required to make hard decisions very early in their careers. While some officers will reject the AAC because of the lack of battalion and brigade command opportunity, others will recognize the rewards and challenges of a career in acquisition management. Neither choice will guarantee success; both require the same determination, leadership qualities, and hard work. The best news is that either choice will offer equal opportunities for promotion, assignments to challenging jobs, and the self satisfaction of leading our soldiers or providing them the best equipment in the world. We encourage all officers to consider the acquisition corps as a rewarding career opportunity.

COL JOHN R. BRAMBLETT is director, Army Acquisition Executive Support Agency which serves as the personnel proponent office for the AAC program and Functional Area 51 (RDA). He is a graduate of Bowling Green State University and holds an M.S. degree in industrial engineering from Georgia Institute of Technology.

LTC DANIEL D. ZIOMEK is proponent manager for the AAC and editor-in-chief of the Army RD&A Bulletin.

BG(P) O'NEILL DISCUSSES ARMY ACQUISITION CORPS

BG(P) Malcolm R. O'Neill, the first director of the new Army Acquisition Corps, wants to ensure that soldiers train with the best equipment available. He says that the goal of the Acquisition Corps will be to provide the Army with a highly competent group of professionals who are efficient in developing and buying dependable hardware for soldiers to carry into combat.

O'Neill, who also serves as the assistant deputy for systems management in the Office of the Assistant Secretary of the Army for Research, Development and Acquisition, sees an already-effective group of acquisition specialists getting better.

"The military personnel will be selected for the Acquisition Corps earlier in their careers, at about their eighth year of service," he explains. "These officers will come from all branches of the Army — more specifically, from the five functional areas, which are 51, 52, 53, 97, and 15/35. The primary branches include the combat arms, which are very interested in getting people into the acquisition business and who understand the soldier and how he fights," O'Neill adds.

About 200 officers will be selected for the AAC each year, based on the officers' desire to become acquisition specialists and the needs of the Army.

"It's essential that (the AAC) be representative of all the branches because our hardware in the Army is used by all the branches," he says. "I think the best person to be responsible for developing the hardware used by an infantry or tanker is a person who 'feels' the infantry and the armor best. That might not necessarily be an infantry officer or armor officer, but it usually is.

"Let me emphasize the fact that the officer would continue to wear his branch colors (and insignia). He would continue to be affiliated with the infantry, the armor, the artillery, the Signal Corps. The Acquisition Corps will be a specialty."

The Acquisition Corps also relies on capable civil servants to support the Army. O'Neill explains that civilians will also enter the AAC at GM-13 grade levels and would come into the program out of about 10 career fields.

The streamlined AAC chain of command is also headed by a civilian called the Army acquisition executive who is the assistant secretary of the Army for research, development and acquisition. Stephen K. Conver was sworn in earlier this year as the new assistant secretary of the Army for RD&A.

The AAC evolved from the Defense Management Review, the Defense Department's effort to focus the chain of responsibility for developing and buying equipment. The previous acquisition process was perceived as not being managed by career professionals, O'Neill says.

"Project managers will report to the Army acquisition executive through only one layer of management, and that layer of management will be the program executive officer," O'Neill says. "The PEO, as we call him, is either a civilian, senior executive service member, or an Army general officer. That PEO will be responsible for several project managers, both project managers of major programs (such as the Abrams Tank System) and project managers of smaller programs, some of whom are are called product managers (the Firefinder Radar's product manager).

"The project manager's position has the rank of colonel or the grade of GM-15, and the product manager is a lieutenant colonel or GM-14.

"In this time of evolution of the Army, we are looking at an Army that needs to very wisely expend its resources, both in terms of personnel and hardware," O'Neill said. "The Acquisition Corps is going to be an insurance policy."

AAC Candidate Officer (4M) Information

Recent restructuring of the MAM Program eliminates skill 6T from both authorization documents (TAADS) and the Officer Record Brief (ORB). The MAM Program has evolved into the new Army Acquisition Corps (AAC). The new skill for AAC Candidate Officers, Skill Code 4M, will not be documented on authorization documents. It will however, be reflected in the ORB.

AAC officers are reminded to update their preference statements at least once each year, and to ensure a current copy is posted with the Career Management Information File (CMIF) in the Military Acquisition Management Branch at the Army Personnel Command (PERSCOM), 200 Stovall Street, Alexandria, VA, 22332-0411. Home and duty telephone numbers should also be included with the preference statement. This will allow PERSCOM assignment managers to maintain close contact with AAC officers.

The accuracy and update of the ORB is of paramount importance to the Army and to an officers's career. Items indicated in the ORB should be read carefully by the officer concerned during annual birth month reviews, or when otherwise required. An officer's signature on the ORB is a verification of the correctness of that document.

AAC In DA PAM 600-3

Recent revision of the Army MAM Program and establishment of the Army Acquisition Corps (AAC) have resulted in extensive changes to DA PAM 600-3, Commissioned Officer Professional Development and Utilization. Specifically, a major revision has been proposed for Chapter 101, the Materiel Acquisition Management (MAM) Program. Major revisions have also been submitted for FA 51, Research, Development and Acquisition (Chapter 51) and FA 97, Contracting and Industrial Management (Chapter 97). It is anticipated that these changes will be published in the next issue of the Officer Ranks Update, scheduled for release in the May-June 1990 timeframe.

Army Acquisition Corps Points of Contact

In the March-April 1990 edition of the Army RD&A Bulletin, a listing of those organizations and individuals directly involved in the management of the Army Acquisition Corps (AAC) was provided. Many changes have occurred since the publication of that listing. A revised listing is provided for your information.

Army Acquisition Corps
Office of the Assistant Secretary of the Army (RD&A)
ATTN: SARD-AC
Washington, D.C. 22310

		(202) 69 -
BG(P) Malcolm R. O'Neill	Director	225-3115
COL Al Greenhouse	Dep Director for Mil	223-7323
Andrea Garcia	Dep Director for Civ	223-7324

Army Acquisition Executive Support Agency
ATTN: SFAE
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

		(202) 274-
COL John R. Bramblett	Director	284-9710
Robert L. Michellon	Deputy Director	284-9570
LTC Daniel D. Ziomek	AAC Proponent Ofcr	284-9570
Dale R. Fradley	PM Spec (Policy)	284-9571
M. Susan Hubbard	PM Spec (PM Boards)	284-9571
CPT Kevin R. Norgaard	FA51 Proponent Ofcr	284-9572
Karen A. Walker	FA51 Proponent Ofc	284-9572
James M. Welsh	AAC Proponent Ofc	284-9575
Harvey L. Bleicher	RDA Bulletin	284-8978
Melody B. Ratkus	RDA Bulletin	284-8978
Janet M. Jones	Administrative Ofcr	284-9575
Elaine F. Schalow	Secretary	284-9710

U.S. Contracting Support Agency
(FA 97 Proponent Office)
ATTN: SFRD-KM
Washington, D.C. 20310-0103

		(202) 756-
BG Nicholas R. Hurst	Director for Contracting	289-1700
CPT Andy Mills	FA97 Proponent Ofcr	289-1700
Jim Vann	Procurement Analyst	289-1700
Janet Wolfinger	Procurement Analyst	289-1700

U.S. Army Combined Arms Center
(FA 52 Proponent Office)
ATTN: ATZL-CAD-N
Fort Leavenworth, KS 66027-5300

		(913) 684-
MAJ Frank R. Mann IV	FA52 Proponent Ofcr	552-2133

U.S. Army Signal Center and School
(FA 53 Proponent Office)
ATTN: ATZH-POO
Fort Gordon, GA 30905-5300

		(404) 791-
LTC Doyle A. Buck	FA53 Proponent Ofcr	780-7388
Dallas Grimes	ACS/TWI Coordinator	780-2267

U.S. Total Army Personnel Command
ATTN: TAPC-OPB-A
200 Stovall Street
Alexandria, VA 22332-0411

		(202) 325-
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LTC Donald E. Ramsey	Ch, Military Acq. Mgt. Branch	221-3125
CPT Corwyn B. Tiede	FA51 Assignments Ofcr	221-3125
CPT Gary Kinne	FA51 Assignments Ofcr	221-3125
MAJ Charles F. Vondra	FA52/97 Assignments Ofcr	221-2758
MAJ Bruce Bachus	FA53 Assignments Ofcr	221-2757
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CPT Thomas H. Hogan	FA51 Force Read Ofcr	221-3125
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CPT Debra J. Chase	FA51 Force Read Ofcr	221-3125
CPT Lacey Hughes (Jul 90)	FA97 Force Read Ofcr	221-3125
CPT Cynthia J. Camperson	FA53 Force Read Ofcr	221-3125
COL Roy Beauchamp	COL Div, Assignment Ofcr (TAPC-OPC)	225-7878

Successful Valve Test Completed

Earlier this year and under contract to the U.S. Army Strategic Defense Command's (USASDC) Ground Based Interceptor-Experiment (GBI-X) Office, Societe Europeenne de Propulsion (SEP) of France conducted a highly successful test firing of a prototype rotating dome valve.

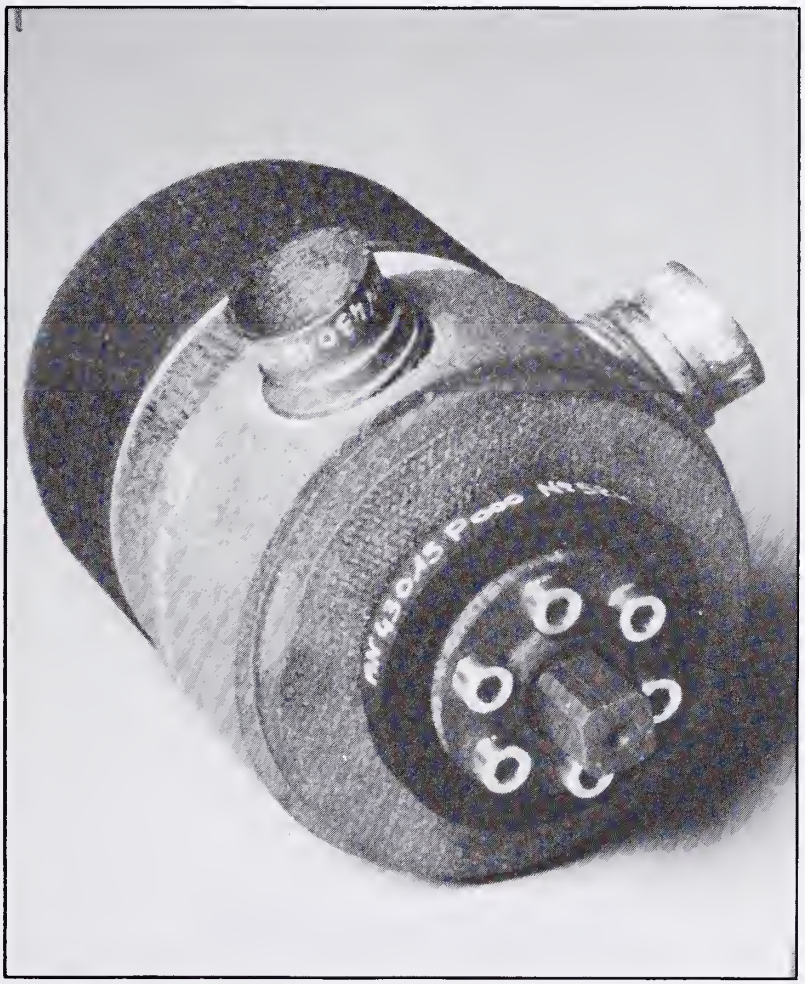
This was the first such test of a composite valve at elevated temperatures and pressures, and was described as "a major technological advance" by Robin Buckelew, chief of the GBI-X Office. The use of composite valves in interceptor divert and propulsion systems provides light weight alternatives to standard metal valves. In general, lighter weight components ultimately result in lower-cost systems.

On Jan. 23, 1990, SEP's two-axis rotating dome valve (RDV) survived a series of hot gas pulses for 18 seconds, without showing signs of erosion or damage. The hot gas source was a non-aluminized composite propellant with a flame temperature of 2,364 degrees K (3,795 degrees F) at a pressure of approximately 4.00 MPa (580 psi) and a theoretical specific impulse of 262 seconds. Following disassembly, a visual inspection of all of the components after the test firing revealed no erosion or damage.

The successful test results will justify the use of composite materials technology for moving parts in high-temperature, high pressure divert and propulsion systems applications for GBI and other programs.

The French company performed the test firing under a six-month Broad Agency Announcement GBI-X Office contract awarded in 1989. GBI-X is managing studies and experiments for the application of current advanced technologies to mid-course interceptor components.

SEP is recognized widely as a European leader in the design and manufacture of rocket motors and composite materials for propulsion and other applications. The Solid Propulsion and Composites Division of SEP, located near Bordeaux, France is perfecting the hot gas steering technology which led to last month's encouraging performance of the all-composite, lightweight rotating dome valve.



Prototype Rotating Dome Valve.

TACOM Signs Cooperative R&D Agreement

U.S. Army Tank-Automotive Command, (TACOM) Deputy for Research, Development and Engineering Dr. Kenneth J. Oscar and Robert E. Meredith, president of the Ann Arbor-based Optimetrics, Inc., signed an agreement earlier this year that allows Optimetrics to use TACOM- developed software that enhances computer-aided design (CAD).

The pact, the first of its kind involving TACOM, is known as a Cooperative Research and Development Agreement (CRDA). CRDAs fall under the Federal Technology Transfer Program. This program's purpose is to encourage federal laboratories and R&D centers to enter into agreements with either state and local governments or industrial concerns which allow them to use technologies developed by federal agencies that might otherwise go unused. Under terms of these agreements, the user must pay royalties to inventors for the right to use their inventions.

The TACOM CRDA allows Optimetrics to use a software package called FRED (Faceted Region Editor), which was developed by TACOM RDC Center engineer Jack Jones. FRED can provide engineers with more detailed design analyses than those produced by conventional CAD software and can thus be used for virtually any mechanical design problem. Unlike other CAD software, which produces solid-geometric images, FRED can create faceted representations of three-dimensional objects as a stand-alone CAD program. It can also be used with other programs to convert standard three-dimensional solid models into faceted models.

Jones said the potential for commercial application of FRED is great. "This software package can be used for a variety of 3-D CAD applications, including modeling of thermal, infrared, radar and visual signatures of vehicles," Jones said.

During the signing ceremony, Oscar stressed the importance of the Army sharing its technological inventions with industry. Said Oscar: "When we do this, it is mutually beneficial for everybody. It gives the employees some incentive and reward. It also encourages government labs to try to find technology that might be applicable in the commercial market. And, of course, it helps companies to get technologies that their tax dollars paid for." When asked how he thought FRED would help Optimetrics — a defense contractor whose business consists largely of evaluating target thermal signatures for the Army — Meredith said, "I think it is going to do two things for us. It is going to increase the research business we get — spread it out to other customers in the target-signature area. Also, I think it will give us the opportunity to spread to non-defense areas such as the automotive industry."

The preceding article was written by George Taylor, a technical writer-editor for the Tank Automotive Command.

Contract Calls for Miniature Strain Sensor

An 18-month, $216,668 contract for design and development of a smart integrated microsensor system has been awarded by the Aviation Applied Technology Directorate (AATD), U.S. Army Aviation Systems Command (AVSCOM), Fort Eustis, VA, to ELDEC Corp., Lynnwood, WA.

"The objective of this program is to develop a miniature strain sensor that contains enough processing power to precondition the output signal" explained Paul J. Redden, AATD project engineer. "This preconditioning of the sensor output will reduce the susceptibility of the output of noise. It will also reduce the size and weight requirement for post-processing electronics." In addition, the sensor will calculate fatigue lift usage for individual helicopter dynamic components. This will provide a reliable replacement criteria for these costly components.

New Test Facility Opens

Officials at Tobyhanna Army Depot have dedicated a new Test Program Set (TBS) repository. The new facility will enable the depot's Automated Systems Division personnel to expand and improve service to Army users of automated test equipment worldwide.

A test program set is the hardware and software used to connect automatic test equipment (ATE) with the component to be tested, called the unit under test (UUT). The hardware portion consists of cable assemblies and interface devices. The software is made up of technical documentation and the application test program, which is contained on magnetic tapes, discs, diskettes, punched paper or mylar tape.

The TPS are used with the Army's Integrated Family of Test Equipment (IFTE), as well as with the AN/USM-410 EQUATE and the AN/USM- 465A digital card tester. The depot maintains TPS for such systems as the M-1 tank, the Apache helicopter, the TACFIRE artillery control system, Digital Group Multiplexer communications system and satellite communications equipment.

The new 3,360-square foot repository provides much-needed space for working with TPS. The facility is divided into six functional areas: entry, TPS review, TPS assembly and distribution, configuration management and control center, and the repository.

Rock Island Blends Art With Science

Since 1875, Rock Island Arsenal (RIA) has produced goods made of leather, cloth, rubber and other non-metallic materials for the U.S. Army. Cavalry equipment used by Teddy Roosevelt's Rough Riders in Cuba came back to RIA for repair and reissue, and the arsenal was a center for rubber research during World War II.

The cavalry harness shop was once the arsenal's busiest department, and dozens of examples of its work still survive today. All are marked with the personal initials of a leather worker or inspector, a sure sign that the harness makers saw themselves as craftsman.

While Rock Island Arsenal hasn't made any harnesses since 1920, it retains the capability to work with leather and other non-metallic materials in its Pliable Materials Section. There, employees are preparing for the 21st century by holding on to the crafts of the past while using the science of the future.

The old leather craftsmen learned by experience, and usually passed on their skills by word of mouth and one-on-one apprenticeships. But Steve Rose, chief of the Pliable Materials Section, noted that his section was using modern technology to accomplish the same ends.

"We are in the process of setting up a computerized data base to document our skills and record production variables and statistics," Rose said. "There are some very knowledgeable employees here, and future operators will benefit greatly if they leave that knowledge behind."

At times during the Arsenal's history, as many as 1,000 employees and more were involved in the production of goods made from pliable materials. Today, though, the Pliable Materials Section employs four people with a combined total of about 75 years of experience at the Arsenal. According to Rose, that experience has combined with education to produce the high skill level found in the shop.

Because pliable parts go in most Arsenal end products, employees in the section must also be able to communicate and work with other organizations, especially those involved in science, engineering and quality.

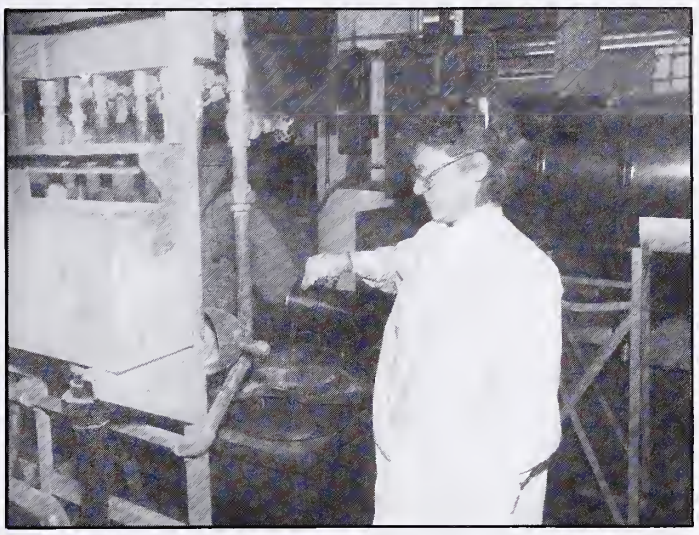
"The cooperation we've received from other directorates has been outstanding," Rose said, "and has been crucial during our most recent project."

That project is the production of rubber obdurator pads for gun tubes. The obdurator pads, which look like black doughnuts, are set inside the tubes to serve as seals and gaskets and to help absorb some of the shock of firing.

All pads must achieve size tolerances measured in thousandths of an inch, and have to be able to withstand a broad range of sudden temperature and pressure changes. Like everyone who makes rubber products, those making the pads must know how to vary aspects of the manufacturing process to achieve a high-quality product.

"Our goal was to control the variables and achieve accuracy and repeatability in the process," Rose said. To do this, the section employed the Taguchi method, a quality control technique which calls for examining all possible scenarios and recording all variables.

The process begins with the selection of base rubbers, and of the chemicals added to them. The rubbers and additives are blended using a formula designed by arsenal scientists to control factors such as strength, pliability, water and oil resistance, and ability to withstand heat and pressure.



Wanda Forsythe blends together some rubber compounds and additives following a formula developed by scientists and engineers at Rock Island Arsenal.

The final blend is then hardened and milled, a process similar to the kneading of dough for bread. The freshly milled rubber is extruded into a rough shape before being molded.

The Pliable Materials Section can perform both compression molding, which involves the use of presses powered by the Arsenal's steam plant, and injection molding, which involves a machine that injects liquified rubber directly into a mold.

The molded rubber must be cured, trimmed, and put through some initial testing before it can be called an obdurator pad.

The Taguchi method experiments performed in the section were successful. The rejection rate on the obdurator pads fell dramatically, while quality and productivity increased. As a result, the section received the Commander's Quality Excellence Award, an award which recognizes the individuals and organizations at the arsenal performing high-quality work.

While the section's rubber manufacturing efforts may have been award-winning, Rose noted that it retained the capability to work with materials such as leather, cloth, plastic, felt and cork. In particular, the section has the blow molding equipment needed to form plastic into any shape imaginable, and the industrial-grade sewing machines needed to work wonders with textiles.

The preceding article was written by Paul Levesque, a public affairs specialist and editor of the Target newspaper, HQ, U.S. Army Armament, Munitions and Chemical Command, Rock Island, IL.

RD&A NEWS BRIEFS

Conver Assumes Post Of Assistant Secretary

Stephen K. Conver has been appointed assistant secretary of the Army for research, development and acquisition. Formerly, he was a member of the professional staff of the House Armed Services Committee (HASC) where he served as principal staff advisor to Congressman Bill Dickinson (the ranking Republican) and the 21 other Republican members of the HASC.

Prior to joining the HASC in December 1985, Conver served for four years on the staff of the secretary of the Air Force as deputy assistant secretary (programs and budget). In that position, he was responsible for overseeing the development, approval, and execution of the Air Force budget.

During nine years service as a commissioned officer in the Air Force, Conver carried out a broad range of assignments, including technical analyses of Soviet weapon systems, long-range planning studies in support of advanced Air Force weapons acquisitions, and analyses of U.S. strategic force options under a SALT agreement.

His academic credentials include a B.S. degree from the U.S. Air Force Academy and a master's degree in operations research from Ohio State University.

Army Saves $10 Million Through Competition

The U.S. Army Aviation Systems Command (AVSCOM) has awarded a contract for a base year and four option years of tri-service H-60 Auxiliary Power Unit (APU) requirements to Garrett Auxiliary Power Division (GAD). Through competition, the Army saved more than $10 million, obtained an improved warranty, and purchased a slightly more capable and reliable APU for the Black Hawk helicopter.

The competitors were Sundstrand and GAPD, both currently producers of APUs for major systems; Sunstrand for the H-60 and GAPD for the AH- 64. This first time breakout competition was conducted with the active cooperation and support of the Black Hawk project manager, and the participation of the Naval Air Systems Command. The results of this competition represent not only an important service to the project manager but also a prudent use and substantial savings of taxpayer dollars.

CONFERENCES

Natick Holds Science Symposium

The U.S. Army Natick Research, Development and Engineering Center, Natick, MA, will hold a science symposium at its Conference Center, June 5-6, 1990. The theme is "The Soldier as a System." Four symposium sessions will be devoted to chemical biological protection, military materials, ration design and food science, and general topics.

The 25 papers planned for presentation will include: "Nephila Clavipes Major Ampullate Gland Silk Proteins: Amino Acid Composition Analysis, Protein Sequencing, Construction and Screening of Recombinant Genomic and cDNA Libraries," and "Numerical Modeling of the Penetration of Airborne Contaminants into Pressurized, Porous Fabric Structures." For more information, contact Thomas A. Sklarsky, Natick's Symposium Coordinator, at (508)651-5330 or AUTOVON 256-5330.

AMSAA Plans Annual Operations Research Symposium

The 29th Annual U.S. Army Operations Research Symposium (AORS) will be held Oct. 10-11, 1990 at Fort Lee, VA. About 300 government, academic, and industrial leaders are expected to participate in the event.

The theme of this year's symposium is "Analysis — Meeting Changing Requirements and New Challenges." The symposium will allow an exchange of information and experiences on significant Army analyses. In addition it is designed to provide a constructive critique while broadening the perspective of the analysis community.

Attendance is limited to invited observers and participants. Papers will be solicited which address the theme of the symposium. Selected papers and presentations will be published in the proceedings.

The U.S. Army Materiel Systems Analysis Activity (AMSAA), directed by Keith A. Myers, is responsible for the overall planning and conduct of this year's symposium. For the 17th consecutive year, the U.S. Army Logistics Center and Fort Lee, commanded by LTG Leon E. Salomon, and the U.S. Army Logistics Management College, commanded by COL David L. Asbury, will serve as co-hosts.

Symposium inquiries should be directed to: Director, U.S. Army Materiel Systems Analysis Activity, ATTN: AMXSY-DA, Aberdeen Proving Ground, MD 21005-5017. Phone inquires should be made to Glenna Tingle, AUTOVON 298-6576, commercial (301) 278-6576 or Margie Stidman, AUTOVON 298-3398, commercial (301) 278-3398.

Battery Waste Seminar Announced

The Second International Seminar on Battery Waste Management will be held Nov. 5-7, 1990 in Deerfield Beach FL. Sponsored by Ansum Enterprises, Inc., and BDT, Inc., Clarence, NY, the seminar will provide a forum designed to educate interested groups relative to managing battery wastes.

Specific seminar information is available from: Dr. S.P. Wolsky, 1900 Cocoanut Rd., Boca Raton, FL 33432 or telephone (407) 391-3544 or FAX (407) 750-1367.



FROM THE ARMY ACQUISITION EXECUTIVE...

With this issue of *Army RD&A Bulletin*, I would like to introduce myself to the many loyal readers of this outstanding professional development publication. Although my name may not be familiar to many of you in the Army's RD&A community, I am well acquainted with the defense acquisition process, having served formerly on the professional staff of the House Armed Services Committee.

I am especially honored to be serving as the Assistant Secretary of the Army for Research, Development and Acquisition at a time when momentous changes and challenges are occurring across the globe and more specifically in the Army's materiel acquisition arena. Recent establishment of the Army Acquisition Corps is but one of these challenges that readily comes to mind. I am firmly convinced that our materiel and weapon systems are only as good as the individuals responsible for developing them and that the Army Acquisition Corps will provide this critical resource.

I am also convinced that *Army RD&A Bulletin* plays a vital role in helping the Army fulfill one of its most important tasks — training and development of the professionals that make up the Army's ranks. The Bulletin is the perfect vehicle for instructing members of the RD&A community relative to RD&A processes, procedures, techniques and management philosophies and to disseminate other information pertinent to the professional development of the RD&A community.

I strongly support *Army RD&A Bulletin* and encourage you to support it by submitting articles that are timely, informative, and interesting. You can count on more news "From the Army Acquisition Executive..." in future editions. The Bulletin's editorial staff welcomes your inquiries and support.

As chairman of the Bulletin's Editorial Advisory Board, I intend to provide whatever assistance is necessary to ensure the continued success of this fine publication.

Stephen K. Conver

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